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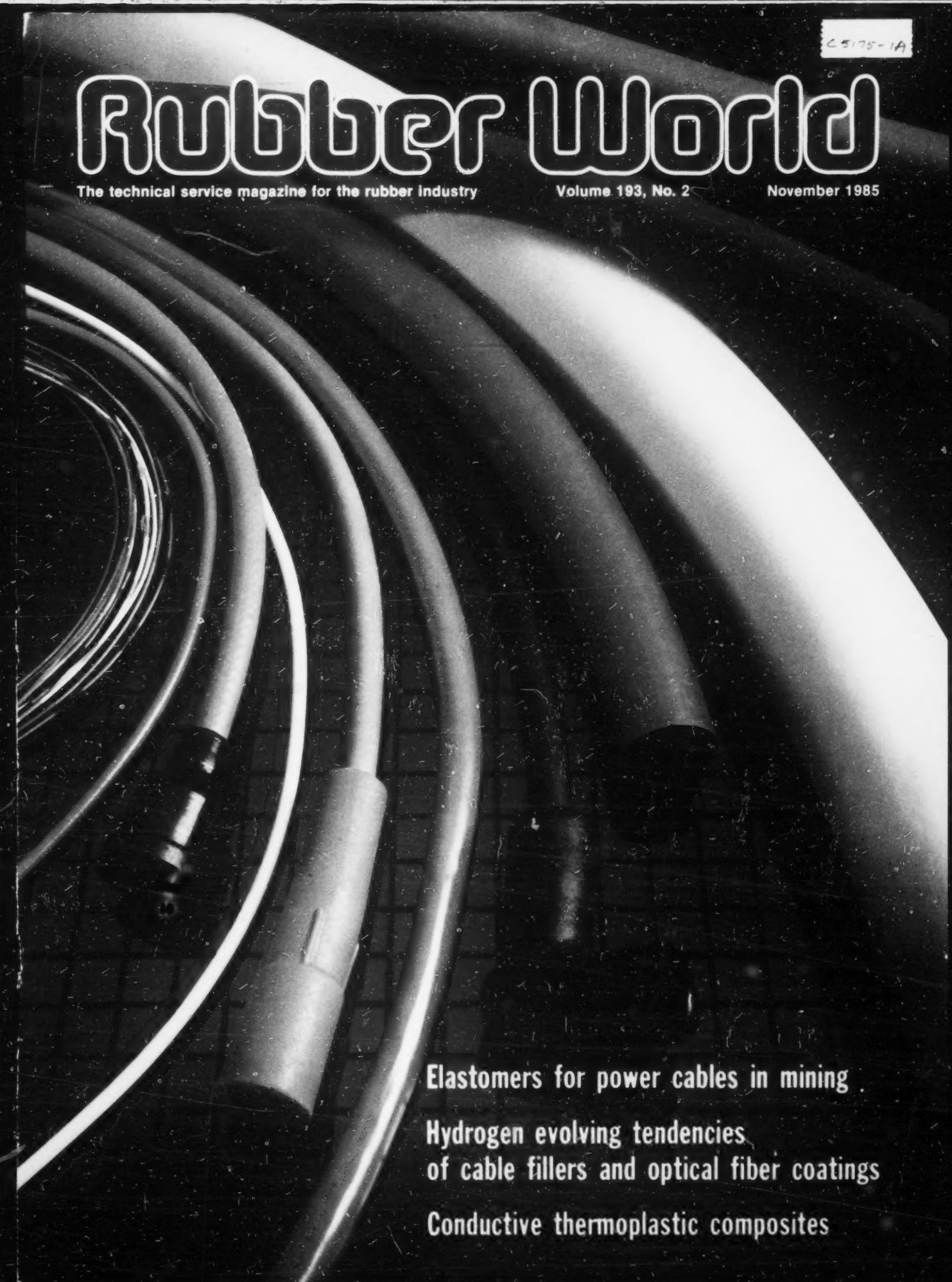
Rubber World

The technical service magazine for the rubber industry

Volume 193, No. 2 November 1985



Elastomers for power cables in mining

Hydrogen evolving tendencies of cable fillers and optical fiber coatings

Conductive thermoplastic composites

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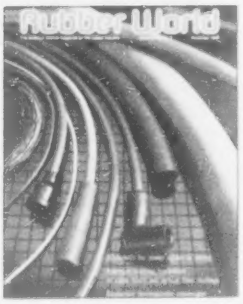

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26 **Hydrogen evolving tendencies of cable fillers and optical fiber coatings**

by William E. Dennis, David A. Sierawski, Donald N. Ingebrigtson, Dow Corning. This article provides experimental data and chemical evidence to demonstrate that silicone materials provide significant value to the optical fiber cable when they are properly selected and used.

30 **Conductive thermoplastic composites**

by J.M. Crosby and J.E. Thayer, LNP Corporation. In this study, a series of conductive thermoplastic composites designed to shield EMI/RFI and provide ESD protection were prepared and characterized, and their properties were analyzed.

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Cover photo courtesy of PPG Silica Division.

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Business Briefs

Acquisitions, expansions

Dunlop Tire has increased production of light truck radial tires at its Buffalo, NY facility by 25% with ongoing expansion that will affect a total increase of 65% in the plants output of these tires by the end of the year.

Kelly-Springfield Tire's Freeport, IL plant will spend $8 million on modernizing and installing production equipment for radial and bias rear farm tires. The project is to be completed in 1987.

Polysar has started pilot plant production of thermal oil resistant rubbers to be marketed under the trade name Tornac in Sarnia, Ontario.

Cancarb Ltd. opened its $11.5 million plant expansion at Medicine Hat, Alberta boosting production by 50% for its medium thermal carbon black.

STATEMENT OF OWNERSHIP MANAGEMENT AND CIRCULATION

(Act of August 12, 1970; Section 3685, Title 39, United States Code)

1A. Title of publication: Rubber World
1B. Publication no.: 00359572
2. Date of filing: 10/1/85
3. Frequency of issue: Monthly
3A. Number of issues published annually: 12
3B. Annual subscription price: $23.00
4. Location of known office of publication: P.O. Box 5485, 1867 West Market Street, Akron, OH 44313
5. Location of the headquarters or general business offices of the publishers: P.O. Box 5485, 1867 West Market Street, Akron, OH 44313
6. Names and addresses of publisher, editor and managing editor: Publisher: Job H. Lippincott, 1867 West Market Street, Akron, OH 44313. Editor: Don R. Smith, 1867 West Market Street, Akron, OH 44313. Technical Editor: David A. Given, 1867 West Market Street, Akron, OH 44313
7. Owner (is owned by Lippincott & Peto, Inc.): Shareholders owning more than 1%: Lippincott & Peto, Inc., 1867 W. Market St., Akron, OH 44313; Job H. Lippincott, 1472 Graham Rd., Silver Lake, OH 44224; John W. Peto, 103 Cedar Lane, Ridgefield, CT 06877
8. Known bondholders, mortgages, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities: None
9. Not applicable
10. Extent and nature of circulation:

	Average no. copies each issue during preceding 12 months	Actual no. copies of single issue published nearest to filing date
A. Total no. copies printed (net press run)	12,270	12,052
B. Paid Circulation		
1. Sales through dealers and carriers, street vendors and counter sales	None	None
2. Mail subscriptions	6,884	6,753
C. Total paid circulation	6,884	6,753
D. Free distribution by mail, carrier or other means. Samples, complimentary, and other free copies	4,465	4,260
E. Total distribution (Sum of C and D)	11,349	11,128
F. Copies not distributed		
1. Office use, left over, unaccounted, spoiled after printing	921	924
2. Returns from news agents	None	None
G. Total (Sum of E, F1 and 2 — should equal net press run shown in A)	12,270	12,052

I certify that the statements made by me above are correct and complete.

Job H. Lippincott
Publisher

Hamilton Mold & Machine, Cleveland, OH has started production of liquid silicone injection molded parts. HM&M previously designed and manufactured the molds.

McCreary Industrial Products has started manufacturing tire-curing bladders at its new facility in Piney Flats, TN.

Midwest Elastomers' de-bottlenecking program at its Wapakoneta, OH cryogenic grinding facility has increased production capacity by over 30%.

Diamond Shamrock Chemicals has agreed to acquire **BFGoodrich's** chlor-alkali and ethylene dichloride facilities in Convent, LA.

Lonza, Inc., Fair Lawn, NJ, has agreed to acquire **Glyco, Inc.** a specialty chemical producer headquartered in Norwalk, CT with plants in Painesville, OH and Williamsport, PA.

The General Polymers Division of **Ashland Chemical** established a thermoplastic distribution district in Portland, OR.

RDN Manufacturing moved to a new facility in Wood Dale, IL doubling production capacity for its extrusion equipment.

Flexible Technologies was one of three Penn Central Corp. units sold to an investor group and executive management of the three companies.

Manville Corp. is relocating its industrial sealing components manufacturing operation to Nacogdoches, TX to a 204,000 sq. ft., three-building, facility.

Thermal Scientific, U.K. completed its acquisition of **Killion Extruders**, Verona, NJ.

Rubbermaid Inc. has acquired **Gott Corp.**, Winfield, KS a manufacturer of insulated coolers, chests and jugs.

Essex Chemical opened its Technical Service Laboratory in Troy, MI to specialize in urethane based sealants, primers, adhesives and coatings aimed primarily at the automotive industry.

Indian Petrochemicals Corp. Ltd. has become the 47th

RMA tire shipments & production report through August 1985 (figures in thousands of units)

Passenger Tires	1985	1984	% Change
Shipments:			
Original Equipment	37,037	34,311	+7.94
Radial	30,839	28,641	+7.67
Replacement	92,141	96,681	−4.70
Radial	73,870	72,343	+2.11
Export	3,438	4,042	−14.94
Radial	2,727	3,000	−9.10
Total	132,616	135,034	−1.79
Radial	107,436	103,984	+3.32
Production	110,397	116,222	−5.01
Radial	87,611	87,250	+0.64
Truck & Bus Tires			
Shipments:			
Original Equipment	5,210	5,269	−1.12
Radial	3,259	2,713	+20.13
Replacement	20,806	20,814	−0.04
Radial	8,842	7,185	+23.06
Export	892	882	+1.13
Radial	461	418	+10.29
Total	26,908	26,965	−0.21
Radial	12,562	10,316	+21.77
Production	23,073	24,356	−5.27
Radial	10,150	9,353	+8.52

Business Briefs

member company of the International Institute of Synthetic Rubber Producers.

Independent Machine Co. has moved to a facility in Fairfield, NJ, doubling the space for its capital equipment.

Nalco Chemical completed its acquisition of **Day-Glo Color**, Cleveland, OH for approximately $40 million.

Cresta Technology, a United Kingdom based producer of polymer filtration equipment has opened a branch office in Lambertville, NJ.

Petroleum Specialties International, Lyndhurst, NJ purchased the **Chesebrough-Pond** white oil and petrolatum plant in Perth Amboy, NJ for $8 million.

Thunderline Corp. opened its new 26,000 sq. ft. combined administrative offices and silicone manufacturing plant in Belleville, MI.

Jones & Vining acquired the operating assets of **Formtex, Inc.**, Warwick, RI, a privately owned producer of polyurethane products, including unit soles for the shoe industry.

RMA rubber report through July 1985 (figures in metric tons)

	Cumulative 1985	Cumulative 1984	% Change 85 vs 84
New Rubber			
New rubber available	1,784,921	1,883,207	−5.22
Imports	658,307	626,128	5.31
Exports	206,848	221,964	−6.81
Apparent Consumption	1,544,909	1,624,316	−4.27
Natural Rubber			
Imports	495,874	483,429	2.57
Exports	23,707	15,990	48.26
Apparent Consumption	470,554	463,223	1.58
% Total new rubber	30.26	28.51	
Synthetic Rubber			
Production	1,126,614	1,258,079	−10.45
Imports	162,433	141,699	14.63
Exports	193,141	205,974	−11.09
Apparent Consumption	1,084,355	1,161,092	−6.61
% Total new rubber	69.73	71.48	
SBR			
Production	484,627	572,486	−15.35
Imports	56,579	43,544	29.94
Exports	47,674	63,951	−25.45
Apparent Consumption	499,000	531,240	−6.07
Nitrile			
Production	34,870	38,650	−9.79
Imports	7,056	6,316	11.72
Exports	3,346	4,769	−17.26
Apparent Consumption	36,144	39,417	−8.30
Polybutadiene			
Production	209,667	217,177	−3.46
Imports	41,509	39,702	4.55
Exports	14,288	13,635	4.80
Apparent Consumption	225,756	239,766	−5.84
Ethylene-Propylene			
Production	134,146	131,423	2.07
Imports	560	650	−13.85
Exports	20,803	20,905	−.49
Apparent Consumption	108,516	102,672	5.69
Butyl, Polychloroprene, Polyisoprene, Silicone and other Synthetic Elastomers			
Production	263,282	298,339	−11.75
Imports	58,727	50,887	11.48
Exports	98,420	102,714	−6.13
Apparent Consumption	214,939	247,997	−13.33

Contracts, licenses

National-Standard, Niles, MI is the exclusive North American sales agent for tire production machinery made by **Herbert Maschinen und Anlagen GmbH** of West Germany.

Wabash Metal Products through an agreement with the Stokes Division of **Pennwalt Corp.**, will produce and market the Model 741 automatic compression molding press.

Fairmount Chemical, Newark, NJ through an agreement with **Phoenix Chemical Co.** has exclusive rights to market in the U.S. polymer additives which were developed by Adeka Argus Chemical, Tokyo, Japan.

Petroflex Industrial E Comercioa S/A appointed **Internor Trade**, Houston, TX at its North American agent for its synthetic rubber, latex and styrene.

Pioneer Asphalt Corp., Lawrenceville, IL named **Harwick Chemical Corp.**, Akron, OH to handle exclusive sales and marketing of its mineral rubber, a processing aid and extender, to the U.S. rubber industry.

Battelle has been chosen by the National Aeronautics and Space Administration to establish a center for conducting advanced materials research necessary for the commercial development of space.

Resinall Corp., Stamford, CT has expanded the **T.H. Hilson Co.** territory to include Minnesota for its hydrocarbon and rosin based resins.

Financial statements

Blasius Industries reported first quarter earnings of $193,000 on sales of $10 million.

Carlisle Corp. reported third quarter net earnings were $6.9 million on sales of $122.9 million.

Cooper Tire & Rubber had third quarter sales of $144.4 million and net income of $5 million.

Eagle-Picher reported operating earnings for the third quarter of $14.7 million on sales of $150.8 million.

GenCorp's third quarter net income totaled $33.7 million on sales of $752 million.

Lydall, Inc. reported third quarter sales of $24.6 million and earnings of $580,000.

Myers Industries reported third quarter net sales of $21 million and income of $929,659.

Markets, news

U.S. tire manufacturing capacity was trimmed by announcements from **Firestone, BFGoodrich** and **Armstrong** that they intend to close some plants. Firestone is closing its passenger tire plant in Albany, GA and terminating production of passenger and truck tires in Des Moines, IA, where it plans to consolidate agricultural tire production. BFG said it would close its Oaks, PA tire manufacturing plant in April, 1986 and in February will shut down its Miami, OK plant, ending its production and marketing of farm equipment tires, off the-road vehicle tires and radial heavy-duty truck tires. Goodrich also announced it was selling most of its tire stores to a corpora-

Business Briefs

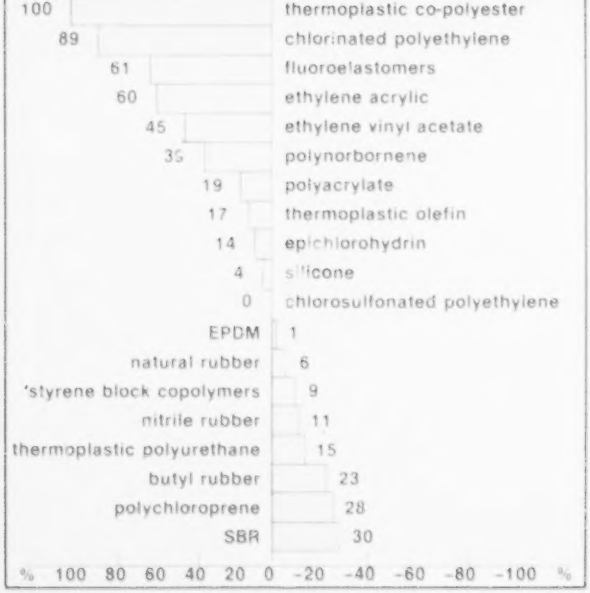
tion headed by James Berlin, currently group vice president administration, Tire Group. Armstrong said it was going to close its Hanford, CA plant in April 1986. That plant manufactures passenger radial and light truck radial tires for the replacement market.

A study by **Gabris International** sees consumption of non-tire automotive elastomers remaining constant through 1990 for the United States and western Europe. The study defines consumption at approximately 615 million pounds in 1983 with little change expected for the end of the decade. The changes will occur in market share increases pegged for thermoplastic co-polyesters (100%), chlorinated polyethylene (89%), fluoroelastomers (61%) and ethylene acrylics (60%) and decreases slated in market share for SBR (30%), polychloroprene (28%), butyl (23%) and thermoplastic polyurethane (15%). The study finds that changes in non-tire elastomer consumption are directly related to several major design and engineering trends related to increased performance, improved efficiency and upgraded quality.

ASTM committee D-24 on carbon black has given approval to the use of Industry Reference Black (IRB) 6 as a replacement for IRB 5. All users of IRB 5 are encouraged to switch to IRB as soon as possible. All carbon black producers plan to report all rubber data versus IRB 6 on or before Jan. 1, 1986. IRB 6 is produced by J.M. Huber. A task group of ASTM subcommittee D24.41 on carbon black nomenclature and terminology is currently gathering rubber data versus IRB 5 from all producers for all current grades of carbon black. This data will be averaged and used for adjusting to IRB 6 typical values, and then incorporated into table 1 of ASTM standard D 1765, classification system for carbon blacks used in rubber products. This data will be made available for ballot and approval by ASTM in early fall.

Automotive elastomers — U.S. & Western Europe 1983-1990 percent growth/decline

Source: Gabris International



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O. Specify
P. Approve

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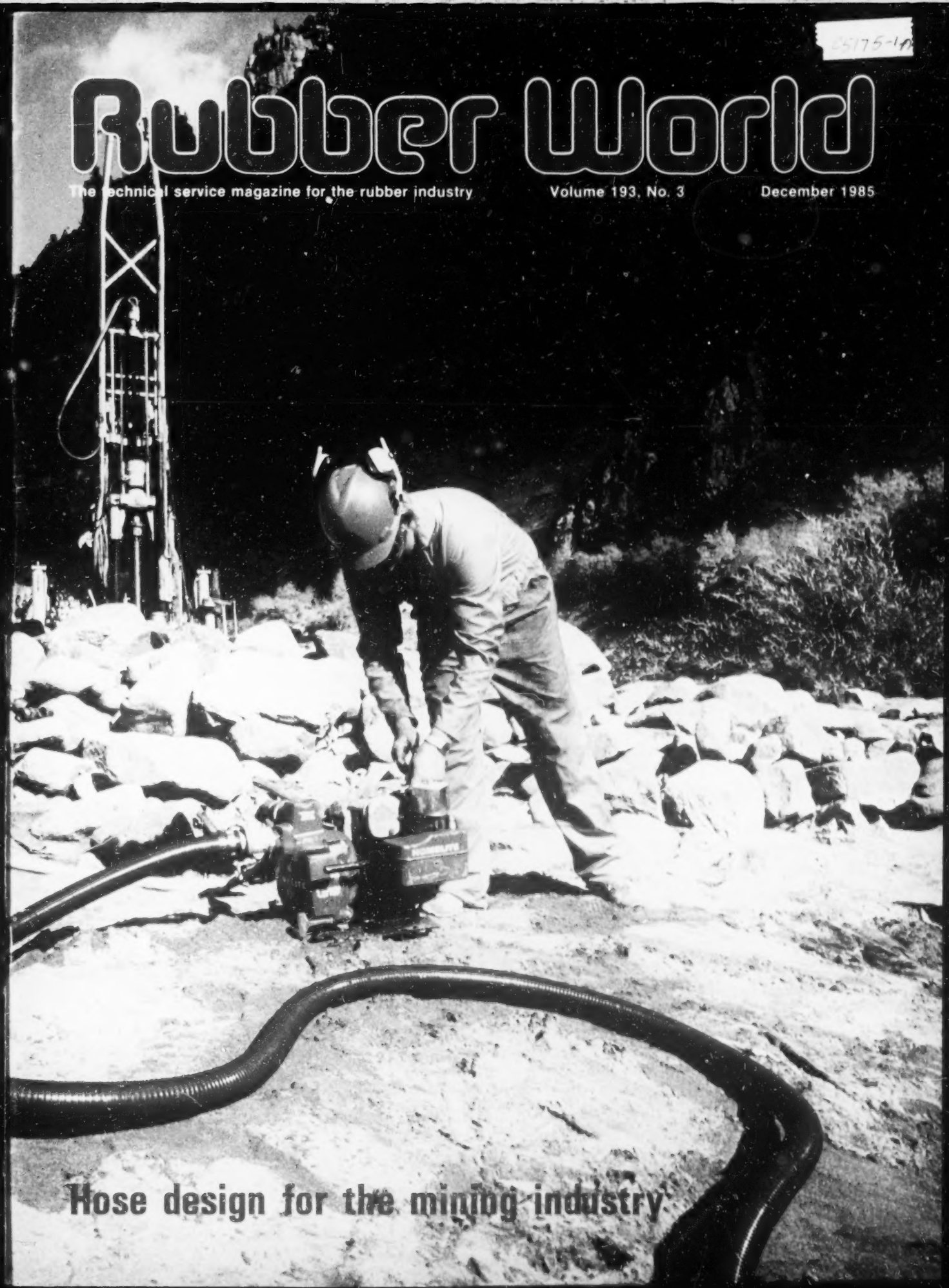
Rubber World

The technical service magazine for the rubber industry

Volume 193, No. 3 December 1985



Hose design for the mining industry

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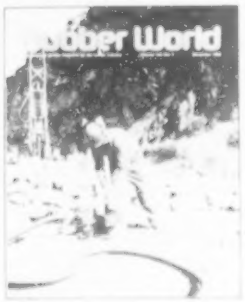

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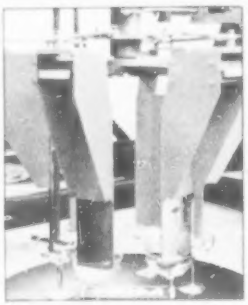

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12 **Tech Service: Getting a charge out of it**
by Jon Menough, contributing technical service editor. The author examines some of the factors involved in making a compound more electrically conductive.

14 **Quality Management: Quality — the cause and error**
by David Crosby, Crosby & Co. This month's column looks at the causes of errors made in quality management, including errors in attitude, ability and basis.

18 **Urethane Forum: Bonding polyurethane — back to the basics**
by Bill Stahl, Brad A Associates. A look at the steps that need to be taken in order to achieve a good bond, whether the substrate happens to be metal, wood, plastic, cured urethane or any other rigid substance.

21 **Hose design for the mining industry**
by John Barnes and Joe Hailey, Gates Rubber Co. This article discusses the principles of proper hose design for mining in terms of product quality, safety and cost, and the selection of elastomers to meet these criteria.

26 **Bonding rubber to brass coated steel for high heat resistant conveyor belts**
by V.M. Murty and D.K. Patel, Nirlon Synthetic Fibres & Chemicals. A high heat resistant compound based on chlorobutyl-EPDM blend will bond to brass coated steel wire used in steel reinforced conveyor belts.

29 **Testing elastomers in multicomponent aggressive environments**
by George C. Derringer and Michael J. Watkins, Battelle. In this study, elastomers were exposed to multicomponent harsh environments typical of deep sour wells and statistical experimental designs were used to estimate the separate effects of each environmental component with high precision.

34 **Low velocity pneumatic conveying of carbon black**
by Urs Maire, Buhler-Miag. The author describes the advantages of low velocity pneumatic conveying over mechanical conveying of carbon black, and explains the operation of the low velocity system.

41 **Technical Focus — Expo '85 featured new equipment, polymers, chemicals**
by David Given, technical editor.

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Cover photo courtesy of Gates Rubber Co.

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ABC

Business Briefs

Acquisitions, expansions

Goodyear has agreed in principle to purchase **Long Mile Rubber** and **AMF Tire Equipment** from **Minstar, Inc.** Long Mile, of Dallas, TX, is the largest full-line tread rubber producer in the U.S. AMF Tire Equipment, based in Buena Park, CA, is now a subsidiary of Mic Tire Equipment (TEI), a wholly owned subsidiary of Minstar. Current management of Long Mile and TEI will operate the units as independent subsidiaries under Goodyear's Tire Division. Long Mile has about 550 employees; TEI has approximately 200 workers in its worldwide operations. Goodyear's purchase of the two companies is expected to be completed by the end of this year. The acquisition is subject to government approval.

Blasius Industries has completed and closed the sale of certain assets of its **Heil Grinding Division** located in Rochester, NY. Inventories, customer orders and the on-going business has been sold to **Heil Grinding and Manufacturing**, a newly formed corporation, for consideration, principally, consisting of a cash payment of $53,000, and the assumption of trade payables totalling $180,000. Machinery and equipment of the Division was sold for $281,485 in cash to **Glasgow, Inc.** Heil Grinding and Manufacturing will lease such machinery and equipment from Glasgow and operate at the Rochester, NY facility utilized by the former Division.

Mace Adhesives and Coatings has announced the completion of its production and R&D facilities, adding more than 10,900 square feet of space. The company's manufacturing capacity has been increased more than 100% by the addition of four reactor kettles. The company has also constructed a separate quality control laboratory next to its manufacturing facility. Mace's R&D laboratory has been doubled in working space and new equipment has been purchased.

Cooper Tire and Rubber has entered into a letter of intent to acquire **North American Rubber** and **Rio Grande SerVass, S.A. de C.V.** Both of these companies were established to continue the inner tube business of the **Indianapolis Rubber Company**.

Borg-Warner Chemicals announced it will build a thermoplastics facility at Shelbyville, KY to compound Cycolac brand ABS and Prevex brand engineering polymer.

Leland-Gifford of Akron, OH has purchased the cartridge screen changing product line, developed for use on thermoplastic extruders, of **Heston Products**.

Columbia Cement of Freeport, NY has completed a $2 million plant expansion that will provide an additional four million gallon annual capacity.

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RMA rubber report through October 1985 (figures in metric tons)

	Cumulative 1985	Cumulative 1984	% Change 85 vs 84
New Rubber			
New rubber available	2,004,811	2,137,971	−6.23
Imports	729,061	701,466	3.94
Exports	244,460	257,730	−5.15
Apparent Consumption	1,744,581	1,854,219	−5.91
Natural Rubber			
Imports	541,898	540,566	.25
Exports	26,424	19,351	36.55
Apparent Consumption	517,858	519,280	−.27
% Total new rubber	29.68	28.00	
Synthetic Rubber			
Production	1,276,730	1,436,505	−11.19
Imports	187,183	160,900	16.33
Exports	218,036	238,379	−8.53
Apparent Consumption	1,226,723	1,334,938	−8.11
% Total new rubber	70.31	71.99	
SBR			
Production	547,356	650,785	−15.89
Imports	64,995	48,837	33.09
Exports	54,917	72,956	−24.73
Apparent Consumption	567,749	614,804	−7.65
Nitrile			
Production	39,682	43,692	−9.22
Imports	8,096	7,935	2.03
Exports	4,447	5,346	−16.82
Apparent Consumption	41,421	44,397	−6.70
Polybutadiene			
Production	233,255	247,460	−5.74
Imports	48,314	44,659	8.18
Exports	16,416	15,699	4.57
Apparent Consumption	266,203	274,140	−2.89
Ethylene-Propylene			
Production	151,876	149,446	1.63
Imports	629	700	−10.71
Exports	24,343	24,077	1.10
Apparent Consumption	122,546	117,030	4.71
Butyl, Polychloroprene, Polyisoprene, Silicone and other Synthetic Elastomers			
Production	303,581	345,121	−12.04
Imports	65,153	58,769	10.86
Exports	117,913	120,301	−1.99
Apparent Consumption	238,802	284,564	−16.08

Business Briefs

Parker Hannifin recently acquired from **Scovill** substantially all of the operations of its **Schrader Bellows** subsidiary, a worldwide producer of pneumatic products and automation systems. Parker paid $63.4 million in cash, and will subsequently pay approximately $14.1 million upon its acquisition of Schrader's remaining foreign operations.

Ingersoll-Rand has purchased the **Fafnir Bearing Division** of **Textron**, and has merged the ball bearing manufacturer into **The Torrington Company**, a wholly owned subsidiary.

Sealed Air has announced the formation of **Static Inc.**, a **Sealed Air Company**, to support the corporation's static control and clean room environment product lines.

Imperial Chemical Industries Plc (ICI) and the French company **Shell Chimie** are having discussions with a view to a new subsidiary company of Shell Chimie, **Societe du Polyethylene de Fos (SPF)**, acquiring the ICI low density polyethylene business based on its 100,000 t/a manufacturing facilities at Fos in the south of France.

Financial statements

American Biltrite reported net earnings of $674,000 on sales of $23.8 million for the third quarter.

Cabot reported fourth quarter net income of $143.5 million on net sales of $349.2 million.

Net earnings of **Crompton & Knowles** in the third quarter were $1.75 million on sales of $56.6 million.

Essex Chemical reported a net income of $1.4 million on net sales of $46 million.

Exxon's third quarter net income was $995 million and revenue for the quarter totalled $22.3 billion.

BF Goodrich reported a third quarter income of $800,000 on sales of $834.9 million.

Jones & Vining announced net earnings for the third quarter were $507,000 on sales of $9.9 million.

Revenues for the third quarter for **Lubrizol** were $203.3 million. Net income for the quarter was $13.6 million.

Parker Hannifin reported net income of $84.1 million on net sales of $1.45 billion for 1985.

Park-Ohio reported net income of $473,000 on net sales of $37.5 million for the third quarter.

Shell Oil's third quarter earnings were $365 million. Revenues were $5.1 billion for the quarter.

Standard Products reported first quarter earnings were $5.1 million on sales of $92.5 million.

Sybron reported earnings of $2.7 million for the third quarter on sales of $128.2 million.

Contracts, licenses

Parlon Chemical of White Plains, NY announced that **Chemcentral Corp.** of Chicago, IL has been appointed the exclusive nation-wide distributor of the Parlon line of chlorinated rubber. Parlon Chemical acquired the Parlon line from **Hercules** of Wilmington, DE in early 1985, and is the only U.S. producer of chlorinated rubber.

D.A. Paulin, Inc. will be the exclusive sales agent for the New England area of **Wyrough and Loser's** line of products, including Poly Dispersion, Bar Form products such as Scorchguard "O" and Zic Stick '85; Promol products, Wyfire products, and Thiocure BR.

Tiros Plastics Products Division of Yonkers, NY has been named marketing specialist by **Shell Chemical** for the Shell Elexar Rubber product line.

RMA tire shipments & production report through October 1985 (figures in thousands of units)

Passenger Tires	1985	1984	% Change
Shipments			
Original Equipment	41,706	38,198	+9.27
Radial	34,747	31,925	+8.84
Replacement	109,043	109,440	-.3.10
Radial	85,529	81,962	+4.11
Export	4,803	4,482	+15.15
Radial	3,002	3,536	+10.01
Total	151,561	152,090	-0.35
Radial	123,278	117,423	+4.95
Production	123,765	130,563	-5.21
Radial	98,594	98,468	+0.09
Truck & Bus Tires			
Shipments			
Original Equipment	3,877	3,905	-0.47
Radial	3,673	3,047	+20.51
Replacement	23,772	23,526	+1.04
Radial	10,209	8,585	+24.73
Export	1,006	1,002	+0.40
Radial	529	462	+14.50
Total	30,655	30,435	+0.72
Radial	14,410	11,694	+23.23
Production	26,598	27,348	-2.89
Radial	12,198	10,422	+19.75

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Business Briefs

Markets, news

Workers at **Uniroyal Chemical** voted to attempt a buyout of the division after the company announced the chemical company was up for sale. Uniroyal announced its intentions to sell the chemical division to finance the leveraged buyout by top management after restructuring the company into five operating subsidiaries. The other four are Uniroyal Tire, Uniroyal Power Transmission, Uniroyal Plastics and Uniroyal Properties.

GenCorp, in a series of restructuring moves announced it would close its bias-tire manufacturing plant in Waco, TX. Production at the plant is scheduled to end late in spring. It currently employs 1,169 hourly and 236 salaried employees. It was General Tire's oldest tire plant and only all bias plant.

Armstrong Rubber cancelled its previously announced closure of its Hanford, CA tire manufacturing plant in response to an endorsement and approval by the United Rubber Workers International of contract changes. The plant produces automobile passenger and light truck radials for the replacement market.

Goodyear ended production at its Akron, OH Chemical Department, laying off 65 hourly and 28 salaried employees. The company will go to the open market and/or other Goodyear chemical facilities for its accelerators and antioxidants. The company also announced that 48 skilled trades employees will be laid off in line with reduced requirements throughout the Akron manufacturing complex.

The U.S. Federal Trade Commission dropped its investigation of U.S. tire companies that stemmed from claims of dumping of tires in the U.S. by Korea. BFGoodrich, Goodyear, Firestone, Armstrong and Cooper filed dumping charges in January with the International Trade Commission. The ITC was investigating whether the U.S. companies were in violation of antitrust laws in fighting the Korean tires entering the domestic market.

A study by Gabris International shows wire and cable consumption of polymeric materials for jackets, insulation and other uses will remain virtually constant through 1990. Demand in most wire and cable market segments especially fiberoptics, flat and ribbon, automotive, control and signal will show substantial growth during the period, but these increases will be offset by major declines expected in conventional communications and building wire and cable. Major opportunities in materials substitution composite construction and blended products exist. PVC, neoprene, chlorosulfonated polyethylene, SBR and LDPE materials will lose significant share. Gains will be achieved by XLPE(cross-linked), irradiated PVC, nylon, fluoroplastics, silicones, CPE, EPDM and various thermoplastic elastomers. The study shows imports could account for 7.7% of the market by 1990.

Polysar Inc. presented the University of Akron a gift of $50,000 for its polymer research center. The gift pushes to $6.8 million the amount raised, with $5 million coming from the state of Ohio. Construction of the first stage of the center will begin in the spring with the entire project to be completed in early 1988.

Rubber City Machinery produced and donated a specially designed mill to be used for work on artificial heart components at the cardiovascular lab at Akron University's Institute for Biomedical Engineering Research.

According to the U.S. International Trade Commission, production of rubber processing chemicals in 1984 dropped 2% from 1983 to 288 million pounds. Sales were of 276 million pounds, valued at $287 million. The production of cyclic rubber processing chemicals increased 6% during the year to 260 million pounds. Of the total production of cyclics, antioxidants, antiozonants and stabilizers accounted for 62% and accelerators, activators and vulcanizing agents 34%. Production of antioxidants, antiozonants and stabilizers amounted to 161 million pounds, which included 98 million pounds of amino compounds and 63 million pounds of phenolic and phosphite compounds. Production of acyclic chemicals amounted to 28 million pounds, a 40% decline from 1983. Dithiocarbamic acid derivatives accounted for 20% of the production of acyclics.

A report from the Malaysian Rubber Research and Development Board shows a slackening in rubber consumption for the first quarter of 1985 despite a 3.7% increase in natural rubber consumption. Consumption of all rubber was up 1.2% to 3.3 million tons. Natural rubber accounted for 1.1 million tons of that figure. Estimated natural rubber production for the first six months of 1985 show a 5.6% increase with Thailand increasing production by more than 28%. Malaysia was the top producer at 355,000 tons followed by Indonesia's 275,000 tons.

Estimated consumption of polymeric materials — wire and cable United States and Western Europe — 1985-1990 (Million Pounds)

	United States		Western Europe	
Material type	1985	1990	1985	1990
All thermoplastics	1,257	1,222	908	899
All thermoset elastomers	131.6	137.0	129.7	144.0
All thermoplastic elastomers	27.9	31.0	10.2	21.7
Totals (million pounds)	1,416.5	1,390.0	1,047.9	1,064.7
(metric tons)	641,333	630,673	475,453	483,076

Source: Gabris International

World rubber consumption, first quarter 1985

	NR + SR		NR	
	'000 tonnes	% change	'000 tonnes	% change
USA	714.3	— 4.4	229.4	+ 7.1
China	160.5	+ 6.3	102.5	+ 2.5
Japan	362.0	+ 2.5	133.4	+ 3.3
West Germany	150.7	— 7.9	51.3	— 2.8
France	114.7	—12.1	42.5	—10.1
UK	98.0	+ 1.0	31.0	+ 0.0
Italy	104.9	+ 6.5	33.7	+ 7.0
Eastern Europe	770.0	+ 5.5	97.5	+ 0.0
South Korea	72.8	+ 1.0	39.3	+14.2
Brazil	81.0	+11.3	24.1	+21.2
India	73.9	+ 8.8	58.3	+ 9.6
Canada	82.0	+ 7.9	27.5	+10.0
Others	58.0	— 5.3	254.5	+ 0.0
Total	3,365.0	+ 1.2	1,125.0	+ 3.7

MRRDB

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Rubber World

The technical service magazine for the rubber industry Volume 193, No. 4 January 1986

Technical Service

Independent test labs: industry's problem solvers

GM's early supplier program

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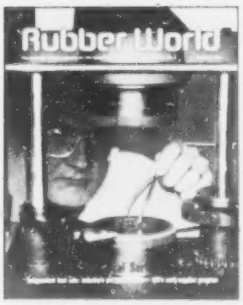

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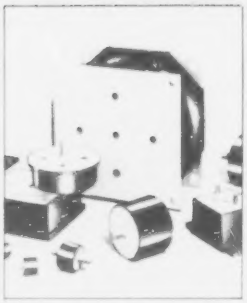

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Cover photo courtesy of Monsanto Instruments & Equipment

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Business Briefs

Acquisitions, expansions

The **Geneva Rubber Co.**, Geneva, OH has been purchased from Robin Industries by Donald P. Reiter. Geneva manufactures custom rubber products primarily for the automotive, trucking, off-highway OEM equipment, and industrial industries.

Gooding Rubber, Pittsburgh, PA, purchased the **Richmond Rubber Co.**, a Kelly Springfield division. Richmond is a distributor of industrial rubber products.

Du Pont plans to construct another plant at its Maydown, Northern Ireland site to produce Kevlar aramid fiber. The $60 million facility will have an annual capacity of 15 million pounds.

Conap, Inc., Olean, NY acquired **D Aircraft Products**, Anaheim, CA a manufacturer of silicone resin systems, silicone rubber extrusions and sheets, a bagging system for composite manufacturing, adhesives, chemical milling products and primers.

Mitsubishi Heavy Industries completed the world's largest tire plant for manufacturing giant-sized tires for Techmashimport, USSR in Bobruisk with the process engineering assistance of Toyo Rubber.

BFGoodrich will establish a new plant at Norwood, NC to manufacture aircraft tires. About 300 persons will be employed when the 300,000 sq. ft. facility is completed and in full operation. BFG also announced that BFG Canada purchased a PVC manufacturing plant at Fort Saskatchewan, Alta. from **Diamond Shamrock** and **NOVA** and the sale of BFG's Convent, LA chlorine, caustic soda and ethylene dichloride manufacturing complex to Diamond Shamrock has been completed.

Goodyear expanded production from five to seven days a week at its Wolverhampton, England plant, primarily for radial truck tire production, adding 350 new workers.

Chem-Trend Inc., Howell, MI acquired the technology, manufacturing and sales rights of **GreenChem Products, Inc.**

Dayco Rubber Products opened a new Chicago area office to house operational, marketing and sales personnel for the company's new Coupled Hose Division.

Neville-Synthese Organics, Pittsburgh, PA signed a letter of intent with **Koppers Co.** to acquire their Oil City, PA facility which produces butylated hydroxy toluene (BHT) antioxidant, mono butyl metacresol and metacresol.

Chemseco opened a 60,000 sq. ft. plant in Pinckney, MI to house its manufacturing division, a research and development lab and warehouse for its adhesives and sealants.

NL Industries sold its Rucker Products division to **Amfac Distribution** for approximately $16 million.

Lauren Manufacturing, New Philadelphia, OH, a producer of silicone and organic closed and open-cell sponge and solid rubber extrusions established a Specialty Automotive Division.

MIR, Brescia, Italy has set up branches in France, USA and Venezuela for sales and service of its injection molding machines.

Chemcentral/Minnesota opened a 25,000 sq. ft. storage depot and warehouse for solvents and chemicals in Lakeville, MN.

Thermal Care/Mayer, Niles, IL increased manufacturing capacity by 10,000 sq. ft.

Biasius Industries sold certain assets of its Heil Grinding Division in Rochester, NY to a corporation headed by Heil president Frank Bryan.

3M Belgium N.V., S.A. announced it has set a target of mid-1986 for increased production of fluoroelastomers to begin at its chemical manufacturing plant in Antwerp. The plant addition will have world-scale facilities for fluoroelastomer polymerization, workup and final finishing, and will supply Europe and other markets outside the U.S.

Expansion and modernization at **Albion Kaolin's** slurry facility in Hephzibah, GA will facilitate the firm's controlled production of pure, high solids, low viscosity kaolin slurry.

Eagle Zinc, a division of **I.L. Diamond and Company**, now manages and operates the **Eagle Picher** zinc oxide plant located in Hillsboro, IL, producers of rubber quality zinc oxides.

RMA rubber report through September 1985 (figures in metric tons)

	Cumulative 1985	Cumulative 1984	% Change 85 vs 84
New Rubber			
New rubber available	2,287,726	2,448,379	-6.56
Imports	815,233	791,312	3.02
Exports	276,514	292,668	-5.52
Apparent Consumption	1,997,393	2,116,644	-5.63
Natural Rubber			
Imports	604,521	609,135	-.76
Exports	29,949	22,802	31.34
Apparent Consumption	585,975	582,926	.52
% Total new rubber	29.33	27.54	
Synthetic Rubber			
Production	1,472,493	1,657,067	-11.14
Imports	210,712	182,177	15.66
Exports	246,565	269,866	-8.63
Apparent Consumption	1,411,417	1,533,718	-7.97
% Total new rubber	70.66	72.45	
SBR			
Production	615,385	732,703	-16.01
Imports	73,992	54,875	34.84
Exports	63,002	81,721	-22.91
Apparent Consumption	642,394	686,417	-6.41
Nitrile			
Production	43,665	49,336	-11.49
Imports	8,859	8,686	1.99
Exports	4,995	5,896	-15.28
Apparent Consumption	46,256	49,851	-7.21
Polybutadiene			
Production	261,349	274,228	-4.70
Imports	53,429	51,052	4.66
Exports	18,767	17,499	7.25
Apparent Consumption	287,633	307,654	-6.51
Ethylene-Propylene			
Production	169,223	169,084	.08
Imports	725	738	-1.76
Exports	27,724	27,083	2.37
Apparent Consumption	136,897	130,815	4.65
Butyl, Polychloroprene, Polyisoprene, Silicone and other Synthetic Elastomers			
Production	382,871	431,716	-11.31
Imports	73,707	66,826	10.30
Exports	132,077	137,667	-4.06
Apparent Consumption	298,237	358,982	-16.92

Business Briefs

Contracts, licenses

Goodyear and the **Formosan Rubber Group Inc.** have formed a joint venture in Taiwan that will produce parts for the world's automotive and industrial markets with the primary product being V-belts.

Japan Butyl Co., a 50/50 joint venture between **Japan Synthetic Rubber** and **Exxon Chemical Eastern**, has completed construction of a halogenated butyl rubber plant at a site in the JSR Kashima plant with an annual capacity of 25,000 metric tons.

Whittaker Corp. and **Shinto Paint Co.**, Tokyo, have entered into an agreement whereby Shinto will manufacture and market Whittaker's Tinxon adhesives in Japan.

J.M. Starkel Co., Troy, MI, has been appointed manufacturers representative for **Fluorocarbon Co.'s** seven rubber group divisions.

Lauren Manufacturing appointed **Todd Stewart and Associates**, Southfield, MI as agents for its new specialty automotive division.

Adamson Chemical and **J.L.K. & Associates** have merged into Adamson Chemical and will represent on the eastern section of the U.S. the following companies: Arco Specialty Chemicals, Synpro Ware Dispersions, Durez Resins & Molding Materials, SerVaas Rubber, Resinall Corp., Hampford Chemicals and ACM Corp.

Wemhoner Anlagen, a German equipment manufacturer, appointed **Dieterich Enterprises**, Akron, OH as its representative for its line of automatic tread booking systems in the U.S.

Uniroyal selected **A-C Supply**, Milwaukee, WI to handle Uniroyal's Powergrip HTD synchronous belt line.

Plastic Service Centers have added **Georgia Gulf** PVC, **Du Pont's** Hytrel polyester elastomer and Texin urethane from **Mobay** along with the services of **Compounding Technology Inc.**, Costa Mesa, CA to its product and service offer.

Capitol Temptrol has appointed the following sales reps for its process liquid control equipment: **W.C. Neumann**, Canton, OH; **Abbott Equipment**, Golden, CO; **Process Engineering**, San Gabriel, CA; **American Plastic Equipment**, Pembroke Pines, FL for Latin America and **American Plastic Equipment**, Miami, FL for the Pacific area and Africa.

Bellofram Corp., Burlington, MA will sell the filter line of **Ultrafilter GmbH**, Dusseldorf, WG.

Carbon black industry in the U.S.A. (metric tons)

		1985 9 Months	Percentage Change 9 Months '85 vs. 9 Months '84
N-100 (SAF)	Prod.	21,468	+ 7.5%
	Ship.	21,117	+ 3.2%
N-200 (ISAF)	Prod.	100,339	(9.0%)
	Ship.	101,227	(7.0%)
N-300 (HAF)	Prod.	374,751	(11.1%)
	Ship.	376,593	(8.1%)
N-500 (FEF)	Prod.	73,769	(14.3%)
	Ship.	75,637	(9.5%)
N-600 (GPF)	Prod.	221,088	(11.4%)
	Ship.	219,666	(10.9%)
N-700 (SAF)	Prod.	82,942	(13.9%)
	Ship.	84,284	(11.4%)
Total	Prod.	874,356	(11.1%)
	Ship.	878,525	(8.9%)
Domestic Shipments (Included Above)		856,247	(9.5%)
Domestic Share		97.5%	

Financial statements

Armstrong Rubber reported net sales for the year of $767.8 million and net income of $16 million.

BASF Group reported earnings for the first quarter of 1985 of $804 million on sales of $10.7 billion.

Firestone reported a 1985 loss from continuing operations of $6 million. Sales totaled $3.8 billion.

Goodyear's third quarter earnings were $56.4 million on sales of $2.36 billion.

Hoechst Group reported worldwide profits before taxes for the first nine months of $770 million on sales of $10.6 billion.

NL Industries had third quarter net income of $5 million on sales of $360 million.

Markets, news

Production of furnace black in the U.S. in the third quarter of 1985 decreased 13% and shipments 6% from the like period of 1984 to 275 and 285 thousand metric tons respectively. Production was the lowest since the second quarter of 1983 and shipments improved slightly over the second quarter, according to Columbian Chemicals.

Year to date production of 874 MMT and shipments of 879 MMT decreased 11% and 9% respectively from the year earlier level. Demand in all grades was down except N-100, up 3%. Plant inventory reduced 10% during the quarter to 91 MMT, a four week supply.

U.S. dry rubber hydrocarbon consumption increased two percent over the second quarter but decreased three percent from the same period of 1984 to 605 thousand metric tons. SBR demand dropped to the lowest in 26 years.

For the first nine months, consumption of 1,868 MMT was 6% below the 1984 level. Both rubber ratios were lower; the synthetic share, from 72.5% to 70.7% and the carbon black, from 47.3 phr to 45.8 per hundred rubber, according to Columbian Chemical.

The International Institute of Synthetic Rubber Producers, Inc. (IISRP) announced that, although final 1985 figures are not yet available, it appears that rubber consumption in North America fell an estimated two percent from the 1984 level. Usage in 1986 is expected to remain at essentially the 1985 level.

Projections of rubber demand through 1990 show a compounded annual growth rate of 0.9 percent — considerably below most GNP projections for the period.

The Institute's Statistical Committee cited the increased penetration of imported tires, automobiles and rubber articles as the major factor in the 1985 decline in North American consumption. Synthetic rubber types used primarily in the tire industry, including styrene butadiene rubber and polybutadiene, reflected the sharpest usage decline. Ethylene-propylene rubber continued to grow, however, due to increased demand in singly-ply roofing and other non-tire applications. These uses are expected to keep demand growing through 1990.

The North American tire industry is expected to show little or no growth during the next five years because of the increased presence of imported tires and longer tire life. These are principal factors in the projections of flat to moderate growth through 1990. The proportion of total new rubber used in tires is projected to decline from 60.6 percent in 1985 to 59.6 percent in 1990.

The U.S. Department of Labor's Occupational Safety and Health Administration proposed reducing workplace permissible exposure levels (PELs) of benzene and formaldehyde. The proposed rules set a new limit for benzene of one part per million parts of air (1.0 ppm) averaged over eight hours — a reduction from the current 10 ppm — and an action level of 0.5 ppm. (Below the "action level" employers would not have to comply with monitoring, medical surveillance and other provisions of the standard.) OSHA is considering two possible permissible exposure limits for formaldehyde, 1.0 ppm or 1.5 ppm averaged over an eight hour workday, depending on results from findings on its link to cancer.

RMA tire shipments & production report through October 1985 (figures in thousands of units)

Passenger Tires	YTD 1985	YTD 1984	% Change
Shipments			
Original Equipment	46,619	42,892	+8.69
Radial	38,888	35,915	+8.28
Replacement	119,588	123,640	−3.28
Radial	96,625	93,146	+3.73
Export	4,060	5,005	−18.88
Radial	3,170	3,661	−13.41
Total	170,267	171,537	−0.74
Radial	138,683	132,722	+4.49
Production	138,338	146,265	−5.42
Radial	110,464	110,675	−0.19
Ending Inventory	—	—	—
Radial	—	—	—
Truck & Bus Tires			
Shipments			
Original Equipment	6,556	6,648	−1.38
Radial	4,131	3,456	+19.53
Replacement	26,894	26,718	+0.66
Radial	11,623	9,416	+23.44
Export	1,125	1,131	−0.53
Radial	602	519	+15.99
Total	34,575	34,497	+0.23
Radial	16,356	13,391	+22.14
Production	29,601	30,783	−3.84
Radial	13,525	11,612	+16.47
Ending Inventory	—	—	—
Radial	—	—	—

5

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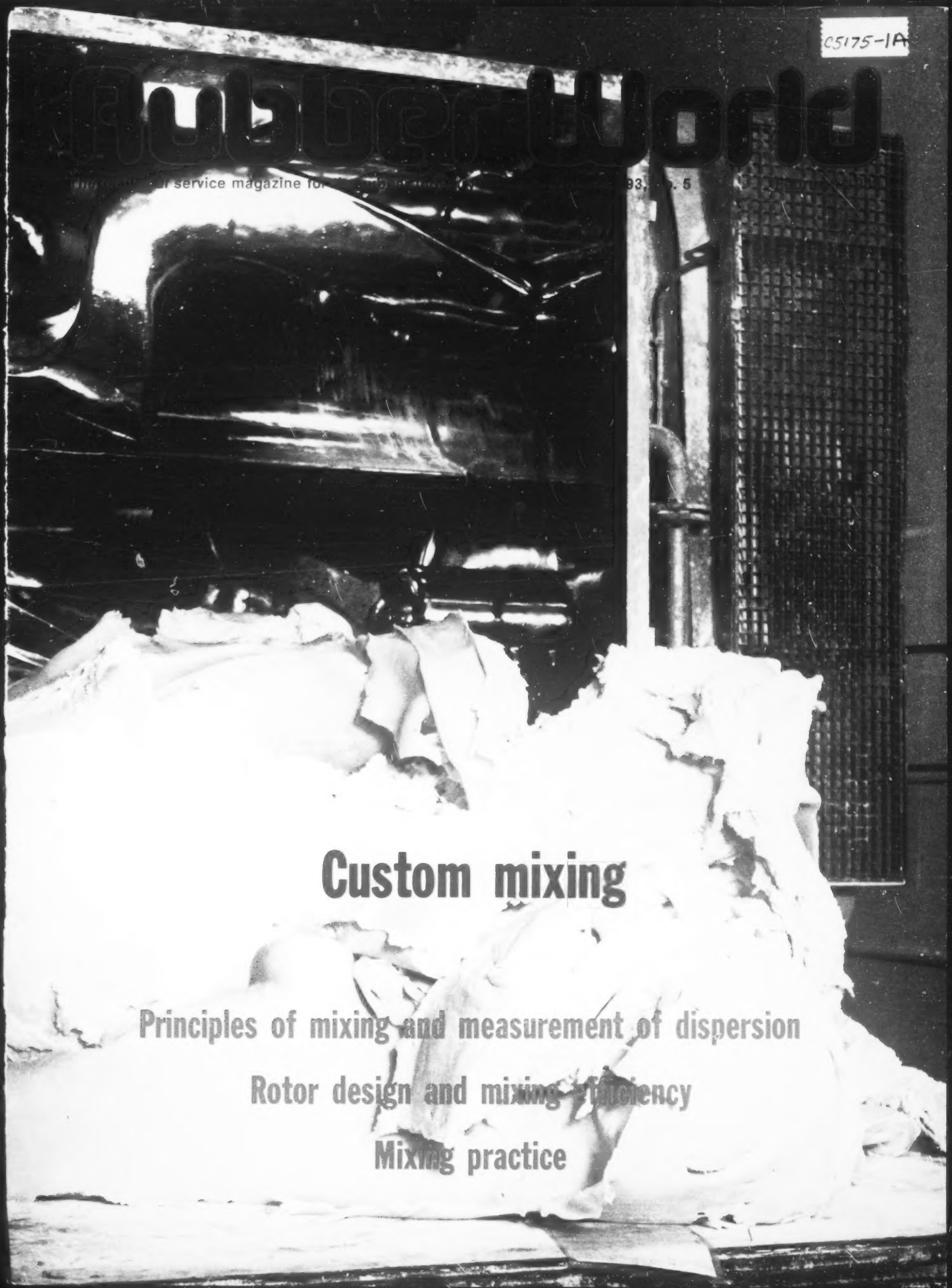

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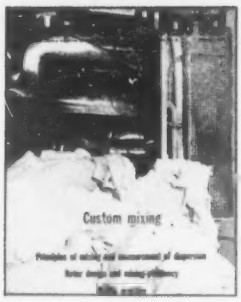

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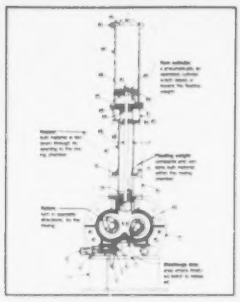

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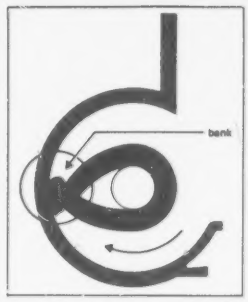

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by Bill Stahr, Brad & Associates. Health screening and periodic monitoring of employees is good for business. Various programs available to employers are discussed.

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by David Crosby, Crosby & Co. A look at closed-loop corrective action for quality departments so they can spend their time preventing defects not managing defective material.

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Business Briefs

The Hudson Die Group, a division of **Hudson Machinery Worldwide**, has announced the opening of a new sales and engineering office in Troy, MI, which will service the upper midwest area.

Monsanto has set up its expanded gas separations business as an incorporated subsidiary under the name of **Permea**.

Chemstress Consultant Co. recently completed a move into its new wholly owned corporate executive offices in Akron, OH.

VenBlack announced the purchase of **Micron Filler**, producers of Kofil 500, and a subsidiary of **Harwick Chemical**.

Pro-Tread of Farmington Hills, MI announced the purchase of **Fruehauf's** truck tire retreading operations. The locations affected include operations in Ft. Worth, TX; Howell, MI; York, PA; East Hartford, CT; and Charlotte, NC.

The Materials, Chemicals and Vehicles Requirements Board of the **Department of Trade and Industry** has agreed to provide up to half of the cost of **Rapra's** Mem-

RMA rubber report through October 1985 (figures in metric tons)

	Cumulative 1985	Cumulative 1984	% Change 85 vs 84
New Rubber			
New rubber available	2,512,136	2,717,181	−7.55
Imports	886,007	875,329	1.22
Exports	305,644	323,415	−5.49
Apparent Consumption	2,218,850	2,365,542	−6.20
Natural Rubber			
Imports	650,545	672,077	−3.20
Exports	32,666	26,341	24.01
Apparent Consumption	633,127	641,216	−1.26
% Total new rubber	28.53	27.10	
Synthetic Rubber			
Production	1,626,129	1,841,852	−11.71
Imports	235,462	203,252	15.85
Exports	272,978	297,074	−8.11
Apparent Consumption	1,585,722	1,724,325	−8.04
% Total new rubber	71.46	72.89	
SBR			
Production	682,081	817,872	−16.60
Imports	82,408	61,304	34.43
Exports	70,245	88,286	−20.43
Apparent Consumption	713,532	772,111	−7.59
Nitrile			
Production	48,819	55,307	−11.73
Imports	9,897	9,785	1.14
Exports	5,496	6,614	−16.90
Apparent Consumption	51,904	55,827	−7.03
Polybutadiene			
Production	284,565	302,073	−5.80
Imports	60,234	56,514	6.58
Exports	20,885	20,220	3.29
Apparent Consumption	320,505	348,115	−7.93
Ethylene-Propylene			
Production	186,053	187,264	−.65
Imports	790	1,020	−22.55
Exports	31,264	29,338	6.56
Apparent Consumption	151,129	146,805	2.95
Butyl, Polychloroprene, Polyisoprene, Silicone and other Synthetic Elastomers			
Production	424,610	479,335	−11.42
Imports	82,133	74,629	10.06
Exports	145,088	152,616	−4.93
Apparent Consumption	348,652	401,467	−13.16

bers Technical Programme during 1986 and 1987. The Programme is valued at over £1.2 million over the two years.

Contracts, licenses

Uniroyal Power Transmission has appointed **Binkelman Bearings**, a distributor of bearings, power transmission components, and industrial hose and fittings, to handle the complete line of Uniroyal power transmission products including belts, pulleys and sprockets.

Federal-Mogul reported completion of the previously announced transactions with **NTN Toyo Bearing Co., Ltd.** for the formation of a jointly owned company which will manufacture and sell tapered and cylindrical roller bearings. The jointly owned company, named **NTN-Bower** has acquired Federal-Mogul's manufacturing operations in Hamilton, AL and Macomb, IL and related research facilities in Ann Arbor, MI for approximately $90 million.

Release Coatings of New York has named **Alcan Rubber & Chemical** the exclusive worldwide marketer for its release agents.

Patented technology for moisture cure silane crosslinking of polyolefin resins is being offered for license by the Specialty Chemicals Division of **Union Carbide**. The technology is based on the use of Union Carbide's proprietary Silcat crosslinking chemicals.

RMA tire shipments & production report through November 1985 (figures in thousands of units)

Passenger Tires	YTD 1985	YTD 1984	% Change
Shipments			
Original Equipment	51,120	47,142	+8.44
Radial	42,631	39,499	+7.93
Replacement	130,691	134,771	−3.03
Radial	106,115	101,917	+4.12
Export	4,317	5,495	−21.44
Radial	3,333	3,998	−16.59
Total	186,128	187,408	−0.68
Radial	152,079	145,412	+4.58
Production	151,099	159,959	−5.54
Radial	121,176	121,373	−0.16
Ending Inventory	—	—	—
Radial	—	—	—
Truck & Bus Tires			
Shipments			
Original Equipment	7,183	7,304	−1.66
Radial	4,543	3,835	+18.46
Replacement	29,588	29,357	+0.79
Radial	12,824	10,416	+23.12
Export	1,233	1,231	−0.16
Radial	661	562	+17.62
Total	38,004	37,892	+0.30
Radial	18,028	14,813	+21.70
Production	31,088	33,735	−7.85
Radial	13,751	12,688	+8.38
Ending Inventory	—	—	—
Radial	—	—	—

Mitchell, the Elkhart, IN manufacturer of cutting and grinding machinery for rubber products, has appointed Sam Di Paolo as the company's sales representative.

Financial statements

Blasius Industries reported net earnings of $324,000 on net sales of $10.5 million for the second quarter of 1985.

Markets, news

The rebound in new car sales to record levels will contribute to slower growth in the automotive replacement products industry in 1986, Goodyear predicts. The belts and hose industry should reach $927 million in retail sales, up 2% from the record $909 million in 1985. Unit sales of V-belts and hoses will increase for the fourth straight year, the company said.

United Rubber Workers president Milan Stone asked the U.S. Congress to place restrictions on imported tires and rubber products to "effectively protect this once-thriving industry from the unfair deluge of imports which is like a growing cancer in our nation." Stone said that imports in the tire replacement market have increased from

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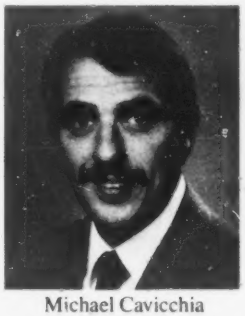
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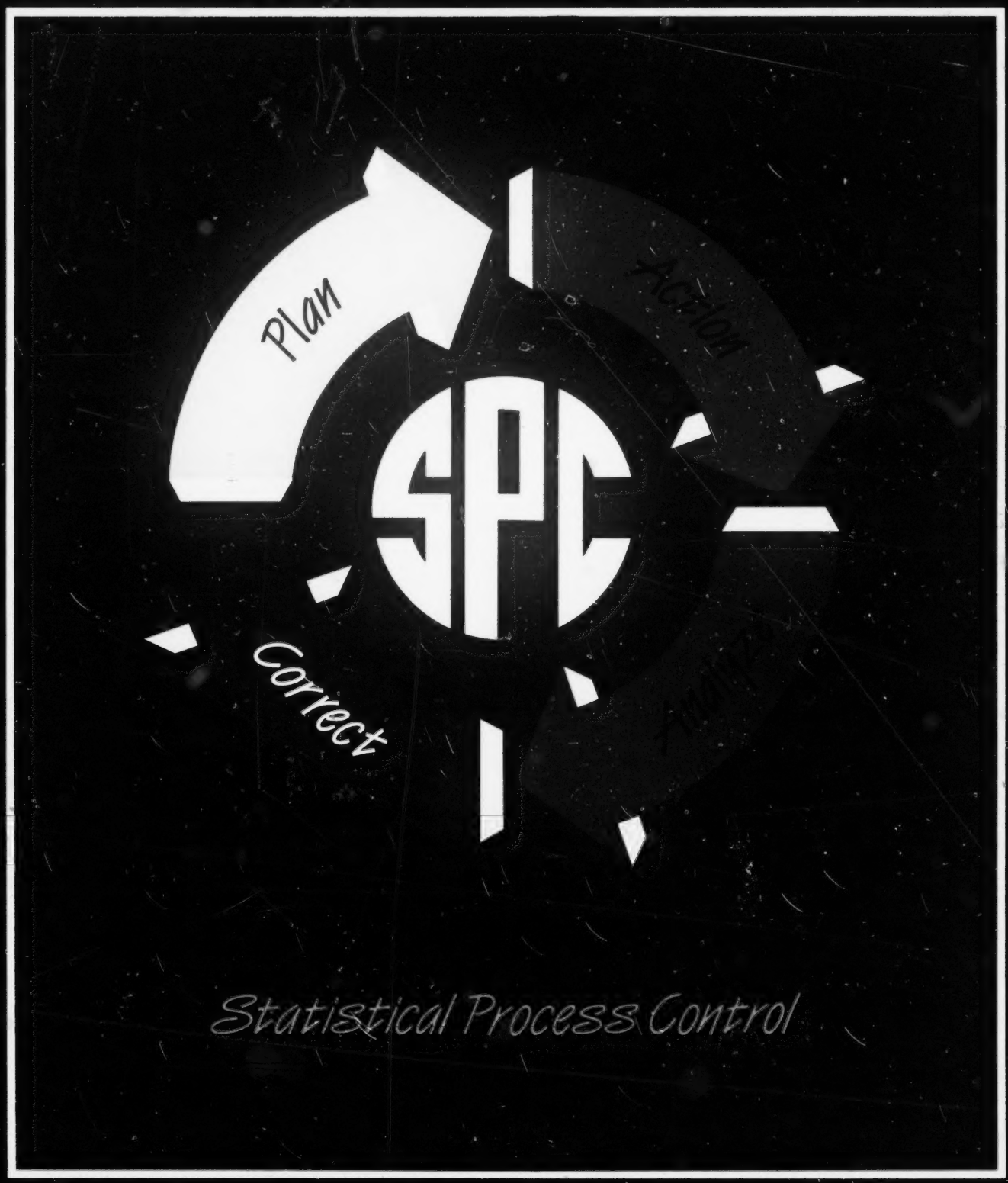
Rubber World

The technical service magazine for the rubber industry

Volume 193, No. 6

March 1986



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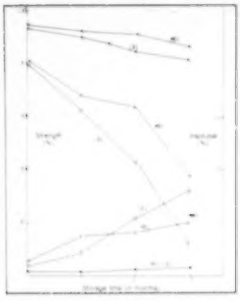

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Acquisitions, expansions; contracts, licenses; financial statements; markets, news.

10 **Tech Service: The deadline approaches**
by Jon Menough, contributing technical service editor. The deadline for the second part of the Hazard Communication Act goes into effect on May 25. Author looks at what the employer must do to comply with the law.

12 **Quality Management: Using SPC**
by David Crosby, Crosby & Co. A look at the many sides of implementing a statistical process control program and the various options available.

14 **Urethane Forum: Industry's problem solvers**
by Bill Stahr, Brad & Associates. A look at how technical service personnel, manufacturers representatives and consultants can aid in problem solving and problem prevention.

16 **Modern scientific methods of testing for the quality of rubber chemicals**
by Guy Bertrand, Vulnax International Ltd. While rubber chemicals represent only a small portion of the finished product their quality should be assessed as critically as the elastomers or fillers. Author describes test methods available to chemists to measure quality.

21 **The new philosophy**
by Jon M. Heslop, Vernay Laboratories. SPC alone cannot correct problems in industry. Author discusses how management must adopt a new philosophy and actively work to remove those barriers that inhibit improvements in quality and productivity.

24 **Total quality management: to make elastomers right all the time**
by John P. Erdman, Du Pont. A look at what Du Pont has done in instituting a quality program throughout the company.

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Cover artwork by Akron artist Judy Everett

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Business Briefs

Acquisitions, expansions

Exxon Chemical Americas has begun production of bromobutyl at its Baton Rouge, LA chemical plant. The company's French affiliate is expanding capacity for ethylene-propylene rubbers at Notre Dame de Gravenchon by 30% to 65,000 tons per year.

Goodyear has agreed to buy up to 63% of the common stock of **Brad Ragan, Inc.** a retailer of new tires and manufacturer of retreaded tires and a leading retreader of off-road tires. Goodyear will operate Brad Ragan Inc. as a separate subsidiary. Goodyear formed **Retread Systems Inc.**, a wholly owned subsidiary comprised of Long Mile Rubber and AMF Tire Equipment, two companies recently purchased by Goodyear. Goodyear also opened a million dollar research and quality control laboratory in Singapore. The lab will aim at improving natural rubber quality.

Firestone plans to spend $240 million in capital expenditures in 1986. $100 million will be for projects in the company's raw material and tire operations in North America; About $67 million for expansion of tire facilities in Brazil, Argentina and Venezuela, and production rationalization in Europe; $43 million for the retail outlet operation; and $20 million for the Diversified Products area.

Chardon Rubber acquired **Beebe Rubber** and **Webster Rubber**, formerly divisions of Mohawk Rubber. Beebe Rubber, Nashua, NH, will be operated as a subsidiary of Chardon, while Webster Rubber, Sabbatus, ME., will become a division of Beebe.

Carlisle Corp.'s SynTec Systems is investing $10 million in new equipment which will allow the company to produce an additional 265 million square feet of single-ply membrane for roofing.

Lydall, Inc. has completed the purchase of **Pantasote's** Elastomer Products Division in Clifton Forge, VA a molded rubber products manufacturer.

Witco's Organics Division established a new laboratory devoted exclusively to surfactant technology for emulsion polymerization at one of its technical centers in Chicago.

Degussa Corp. started operations at a new applications research and technical service laboratory in Allendale, NJ. Completion of the 21,000 sq. ft. facility is expected at years end.

Fruehauf Corp. sold its Pro-Par truck tire retreading operations to **Pro Tread Corp.**, Famington Hills, MI. Sale included retreading facilities in Fort Worthy, TX; Howell, MI; York, PA; East Hartford, CT, and Charlotte, NC.

Ausimont Compo N.V. acquired **Allied-Signal's** fluoropolymer business units for $55 million. Plant facilities in Orange, TX and Elizabeth, NJ were included in the sale.

Lonza Inc. has completed its acquisition of **Glyco, Inc.**, Norwalk, CT. Glyco will initially be a fully operating subsidiary.

Glenro Inc. has opened a new web processing laboratory at its Patterson, NJ facility.

MG Industries has under construction a multi-million dollar air separation unit in Spartanburg, SC that will be operational in early 1986.

Smith & Nephew, Columbia, SC has merged its OpSite and wound care divisions with the Perry division of Affiliated Hospital Products, acquired by Smith & Nephew in 1985. The new division will operate from the Perry division's facilities in Massillon, OH.

RMA rubber report through November 1985 (figures in metric tons)

	Cumulative 1985	Cumulative 1984	% Change 85 vs 84
New Rubber			
New rubber available	2,754,530	2,963,302	-7 05
Imports	979,227	958,528	2 16
Exports	332,203	354,806	-6 37
Apparent Consumption	2,418,559	2,598,297	-6 15
Natural Rubber			
Imports	723,510	735,436	-1 62
Exports	35,860	30,370	18 08
Apparent Consumption	698,834	696,583	32
% Total new rubber	28 65	26 80	
Synthetic Rubber			
Production	1,775,303	2,004,774	-11 45
Imports	255,717	223,090	14 63
Exports	296,343	324,436	-8 66
Apparent Consumption	1,739,725	1,901,714	-8 52
% Total new rubber	71 34	73 19	
SBR			
Production	750,372	889,287	-15 62
Imports	89,110	66,593	33 81
Exports	76,625	96,628	-20 70
Apparent Consumption	777,173	850,214	-8 59
Nitrile			
Production	51,964	61,652	-15 71
Imports	10,919	10,989	- 64
Exports	6,097	7,662	-20 43
Apparent Consumption	56,527	60,761	-6 97
Polybutadiene			
Production	306,846	330,545	-7 17
Imports	66,411	61,617	7 78
Exports	22,016	22,702	-3 02
Apparent Consumption	347,241	380,565	-8 76
Ethylene-Propylene			
Production	204,051	200,840	1 60
Imports	1,073	1,193	-10 06
Exports	33,933	31,358	8 21
Apparent Consumption	165,157	162,741	1 48
Butyl, Polychloroprene, Polyisoprene, Silicone and other Synthetic Elastomers			
Production	462,069	522,450	-11 56
Imports	88,204	82,698	6 66
Exports	157,672	166,086	-5 07
Apparent Consumption	393,625	447,432	-12 03

Contracts, licenses

Uniroyal Chemical appointed **Harwick Chemical** as exclusive distributor of its millable urethanes throughout the U.S.

Montedison USA appointed **Akron Chemical** as exclusive distributor of its line of organic peroxide vulcanizing/crosslinking agents to the rubber industry east of the Rocky Mountains.

Exxon Research and the Commerce Department's **National Bureau of Standards** have entered into an agreement for the development a new small angle neutron scattering instrument, a nondestructive technique with applications in the polymer industry.

Business Briefs

BP Chemicals has licensed **Reichhold Chemicals** to manufacture BP's phenolic foam resin in North America.

Pacific Smelting has signed agreements with **AM&S Europe Ltd.** Bristol, UK and **Sulphide Corp.**, Melbourne, Australia to sell those companies zinc products in the U.S.

Seitetsu, Osaka, Japan has licensed its superabsorbent polymer technology to **Norsolor**, a subsidiary of CdF Chimie, Paris, France.

Financial statements

Armstrong Rubber reported first quarter net sales of $202.1 million and net income of $1.5 million.

Cabot Corp. reported a net income loss of $86.3 million for 1985 with net sales reaching $1.4 billion.

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Eagle-Picher announced a net income loss of $119.8 million for 1985 on net sales of $641.7 million.

Exxon reported net income of $4.8 billion in 1985 on revenues of $93.2 billion.

GenCorp reported 1985 net income of $75.2 million on sales of $3 billion.

Goodyear's net income for 1985 was $412.4 million on sales of $9.6 billion.

Lydall, Inc. reported earnings for 1985 of $4.2 million on sales of $105 million.

NL Industries reported 1985 net income of $21.5 million on sales of $377.1 million.

Rubbermaid had net earnings in 1985 of $57.1 million on sales of $671 million.

Sheller-Globe reported net income for 1985 at 36.7 million on sales of $917.7 million.

Standard Products' net earnings for the second quarter were $5.5 million on sales of $106.4 million.

Markets, news

Shipments of passenger tires in the U.S. were off slightly in 1985 according to the Rubber Manufacturers Association year end figures. Total shipments dropped less than 1% to 200.9 million units. Original equipment shipments increased 7.5% to 54.8 million units but the replacement market was off 2.1% at 141.4 million. Shipments of truck and bus tires increased just less than 1% to 41.1 million units. There was a 7.4% increase in the number of imported radial passenger tires with the total reaching 29.7 million units.

Worldwide consumption of synthetic rubber increased 3% in 1985 and should increase 15% by 1990 according to the International Institute of Synthetic Rubber Producers. Total new rubber consumption is expected to rise

RMA tire shipments & production report through December 1985 (figures in thousands of units)

Passenger Tires	YTD 1985	YTD 1984	% Change
Shipments			
Original Equipment	54,838	50,993	+7.54
Radial	45,773	42,728	+7.13
Replacement	141,455	144,580	−2.16
Radial	115,412	109,498	+5.40
Export	4,625	6,064	−23.73
Radial	3,555	4,375	−8.74
Total	200,918	201,637	−0.36
Radial	164,740	156,601	+5.20
Production	162,583	172,934	−5.99
Radial	130,952	131,512	−0.43
Ending Inventory	—	—	—
Radial	—	—	—
Truck & Bus Tires			
Shipments			
Original Equipment	7,698	7,777	−1.02
Radial	4,895	4,108	+19.16
Replacement	32,098	31,707	+1.23
Radial	14,099	11,332	+24.42
Export	1,335	1,333	+0.15
Radial	723	593	+21.92
Total	41,131	40,817	+0.77
Radial	19,717	16,033	+22.98
Production	33,389	36,441	−8.38
Radial	14,865	13,753	+8.09
Ending Inventory	—	—	—
Radial	—	—	—

from 12.8 metric tons in 1985 to 14.7 mmt by 1990. The sharpest gains will take place in Asia and Latin America, while North America and Europe will post modest growth in the next five years the IISRP predicts.

Asia will represent the largest volume growth with a 19% increase by 1990. Latin America is expected to grow by over 5% each year for an overall growth of 27% by 1990. Meanwhile, consumption in Europe will go up by 10%. North America will post an increase of 5% by the end of this decade. In the same period, the Centrally Planned Economy Countries (CPEC), including Russia and Eastern Europe, will show a growth rate of about 3.6% a year. The People's Republic of China's consumption is forecast to increase almost 10% a year throughout the rest of this decade. Synthetic rubber is projected to represent consistently about two-thirds of total rubber demand, and tire products will continue to consume about 55% of all synthetic rubber.

Total new rubber consumption forecast worldwide (excluding centrally planned economy countries) (thousand metric tons)

	1984	1985	1986	1990
SBR solid	2467	2404	2441	2652
SBR latex*	301	317	325	351
Polybutadiene	969	993	1008	1102
Ethylene-propylene	408	430	444	513
Polychloroprene	250	254	256	270
Nitrile — solid and latex	193	196	199	219
Other synthetic**	813	757	770	870
Total synthetic	5401	5351	5443	5977
Natural rubber	3316	3514	3610	3972
Total new rubber	8717	8865	9053	9949
Synthetic percent (%)	62.0	60.4	60.1	60.1
Carboxylated SBR latex	743	799	804	887

*Excluding carboxylated latex

**Includes butyl and polyisoprene rubbers

New rubber consumption forecast worldwide forecast by region (thousand metric tons)

Synthetic Rubber	1984	1985	1986	1990
North America	2,209	2,033	2,041	2,135
W. Europe, Africa, M. East	1,570	1,585	1,615	1,739
Asia and Oceanica	1,144	1,245	1,266	1,481
Latin America	478	489	521	622
Total	5,401	5,351	5,443	5,977
Natural Rubber				
North America	839	903	902	936
W. Europe, Africa, M. East	983	1,012	1,031	1,096
Asia and Oceanica	1,296	1,398	1,465	1,705
Latin America	198	201	212	235
Total	3,316	3,514	3,610	3,972
Total Rubber				
North America	3,048	2,936	2,943	3,071
W. Europe, Africa, M. East	2,553	2,596	2,646	2,835
Asia and Oceanica	2,440	2,643	2,731	3,186
Latin America	676	690	733	857
World (excluding CPEC)	8,717	8,865	9,053	9,949

Eastern Europe	1984	1985	1986	1990
Synthetic rubber	2,600	2,820	2,955	3,350
Natural rubber	435	430	440	400
Total new rubber	3,035	3,250	3,395	3,750
% synthetic	85.7	86.8	87.0	89.3
China/Asian CPEC				
Synthetic rubber	184	265	290	395
Natural rubber	332	425	460	626
Total new rubber	516	690	750	1,021
% synthetic	35.7	38.4	38.7	38.7
Total CPEC				
Synthetic rubber	2,784	3,085	3,245	3,745
Natural rubber	767	855	900	1,026
Total new rubber	3,551	3,940	4,145	4,772
% synthetic	78.4	78.3	78.3	78.5
Total world				
Synthetic rubber	8,185	8,436	8,688	9,722
Natural rubber	4,082	4,369	4,510	4,998
Total new rubber	12,268	12,805	13,198	14,720
% synthetic	66.7	65.9	65.8	66.0

Rubber consumption in tire and tire products by polymer type; by region (excludes CPEC)

	% Tire and tire products, 1985					
	Western Europe	North America	Asia & Oceanica	Latin America	Africa & M. East	Weighted Average
SBR solid	67.0	71.9	70.1	70.0	60.0	69.6
SBR latex	6.0	6.2	3.1	30.0	2.0	6.1
Polybutadiene	72.0	76.5	68.6	88.0	90.0	74.8
Ethylene-propylene	0.0	6.0	10.6	2.0	0.0	7.4
Chloroprene	0.0	0.0	0.0	0.0	0.0	0.0
Nitrile	0.0	0.0	0.0	0.0	0.0	0.0
Other synthetic*	64.0	50.1	75.0	83.0	80.0	62.6
Total synthetic	49.0	53.9	56.9	69.0	61.0	54.4
Natural	65.0	73.6	63.4	81.0	78.0	67.7
Total rubber	55.0	60.0	59.0	72.0	70.0	59.2

*Includes butyl and polyisoprene

Automotive elastomers: applications, challenges

by T.J. Mao, General Motors Research Laboratories

Introduction

Over 20 years ago, Ralph Wolf[1], who was a rubber chemist and one of the most talented and prolific writers on rubber[2], wrote "Civilization is wholly dependent upon rubber. It is a material of myriad uses, totally unlike anything the world had previously known. . . . It is indispensable in transportation, in communication, — in cushioning our bodies and protecting our senses from the jars and jolts, the noise and tumult of modern life."

For these same reasons, rubber is used in very many applications in the automotive industry. However, the volume of rubber used in the car is decreasing due to downsizing and to the availability of competitive materials. In this article, the current uses and the new challenges and potential applications of elastomers in the automotive industry will be discussed.

Uses of elastomers in automobiles

The automotive industry is a major consumer of elastomers. In an average automobile, about 20 kg of polymer are used in making 63 kg of various rubber compositions for non-tire automotive applications. In contrast, 24 kg of polymer were used for making elastomer parts for a 1979 car. Forecasts of the future growth of elastomers are not very encouraging[3,4]. Projection of rubber demand through 1988 shows an annual growth rate of 2.3% which is below the generally accepted GNP projections of 3 to 4% annually. The decrease in demand is, in part, due to the decrease[5] in total rubber consumption for automotive tire and non-tire applications, as seen in table 1 based on the best available estimate.

The current non-tire uses of elastomers in automobiles can be grouped into the following categories:

Elastomer parts for isolation of bumps and vibrations

These include engine mounts, torsional dampers, jounce bumpers, strut mounts, seat foam, and several other parts. The main requirement for the elastomers used in these parts is that they damp out vibrations of different amplitudes and frequencies ranging from engine noise all the way down to road vibrations. Another essential characteristic is that the damping characteristics and the dynamic properties of these elastomers should not vary much with temperature or frequency of vibration. This latter property is needed to ensure consistent car riding characteristics in cold winters as well as hot summers and on different road surfaces.

Table 1 — amount of elastomer used in an average car

Year	Amount polymer (elastomer), kg
1976	57.5
1979	43.0
1985	39.0
1986	38.5
1987	38.0
1988	37.0

Elastomer components for containing and/or carrying fluids

These components include seals, gaskets, and hoses. Each component is formulated and designed to handle one or more of the many fluids used in automobiles such as fluorinated hydrocarbons (Freons), engine oils, gasolines, hydraulic fluids, and silicone fluids. The main function of these parts is to contain the fluids under all environmental conditions. In many of these applications, retention of properties after prolonged heat aging and retention of flexibility at low temperatures are essential.

In recent years, new performance demands have been placed on these parts because of the many changes taking place in the types and properties of automotive fluids. For example, changes in engine oils were introduced in order to prolong the useful life of the oils at high operating temperatures. To accomplish this, new additives were placed in these oils. Some of these additives were found to react with and degrade some of the elastomer components used in contact with the oils[6,7].

In recent years, we have witnessed the incorporation of several additives in gasoline in order to improve the octane number or to simply extend the gasoline. Some of these additives are ethanol, methanol and methyl t-butyl ether. The addition of these ingredients changes the solubility parameters of the gasoline and, hence, the degree of swelling of the different fuel system elastomers in these mixtures[8,9]. In some instances, it is necessary to change the composition or the elastomer type used for fabricating some of the components in the fuel system in order to ensure proper performance.

Another difficulty with the handling of gasoline has been the generation of partially oxidized gasoline (sour gasoline) in cars using fuel recirculation. Peroxides found in sour gasoline attack elastomers to varying degrees and by different mechanisms[10]. The use of elastomers susceptible to peroxide attack was discontinued in cars with fuel recirculation.

Elastomer components for protection against environment and wear

These components include weatherstrips, front drive axle boots and floor mats. The properties needed for these parts include resistance against wear and tear, fatigue resistance, and, for some applications, low compression set and good oil resistance. The wider use of front wheel drive vehicles created many challenges for the development of a new elastomer composition for the axle boot that will endure the high mechanical stresses and high temperature environment encountered in this application.

In another application, the demand for lower door closing effort necessitated the development of low density elastomer sponge. Intensive investigations were conducted in our laboratories[11] to characterize and identify the processing, morphology and property relationships for low density sponge in order to improve the wear and tear resistance and prolong the useful life of

the sponge in weatherstrip applications.

Elastomers for electrical insulation
Many elastomers including ethylene-propylene-diene (EPDM) rubber and silicone rubber are used in electrical cables and in wiring to insulate the conducting core and protect it against the environment. The important properties required in these elastomers are excellent electrical insulation, even at very high voltages, and excellent aging properties at high temperatures since many of the wires and cables are used under the hood in close proximity to the engine.

Elastomers for improving appearance
Elastomers are used for exterior body parts to perform many functions including improving the appearance. Examples of these include sight shields and body side moldings. High modulus, excellent surface appearance, paintability and resistance to aging by the environment are some of the properties required for elastomers used in these applications.

Elastomers for precision parts
The elasticity of elastomers and their ability to seal against hard surfaces are properties which make them suitable for use as precision metering components such as the carburetor pump cup and the carburetor needle valve. In addition to flexibility, dimensional stability under service conditions including contact with automotive fluids is a major requirement for the elastomer compositions used in these applications.

Elastomers for modifying the properties of plastics
In recent years, the major expansion of elastomers has been as additives in plastics to improve impact strength. Currently, there are many commercial elastomer-plastics compositions with widely different properties extending from high temperature plastics containing elastomers for improving the impact strength to thermoplastic elastomers which are conventional elastomers containing compatible semicrystalline plastics to act as crosslinks under ambient conditions. Elastomers are also added into plastics to modify other properties such as paintability and platability. Many of these elastomer-plastics compositions are used in automotive applications.

These are the major uses of elastomers in the automotive industry. Let us now examine the challenges that lie ahead.

Challenges for elastomers in automotive applications
As all of us are aware, the continuing concern for improved fuel economy has resulted in a significant downsizing and redesign of the automobile. As a consequence, the engine compartment became smaller and more difficult to cool, and the underhood temperature increased appreciably. While a decade ago, elastomers were required to endure a 100°C environment, they are now expected to perform well (and last the life of the car) under a 120°C in-service temperature. We expect that, in the near future, they will be required to live in a 150°C environment for over 100,000 miles.

As a result of the increased underhood temperature, changes in other materials, such as greases, oils and hydraulic fluids, had to be made so that these materials would be capable of performing at the new temperatures. Since, in many instances, elastomers are used to contain these materials, the interactions between them and the elastomers had to be reexamined. There have been cases in which the new fluids degrade some of the elastomer components designed to contain them.

Aside from the temperature factor, there also have been significant changes in the nature of automotive fuels. Additives, such as ethanol, methanol and methyl t-butyl ether, are now being placed in gasoline in order to extend it or improve its octane number. As was mentioned earlier, these additives change the solubility characteristics of the fuel and, hence, the compatibility of elastomers with the new fuels.

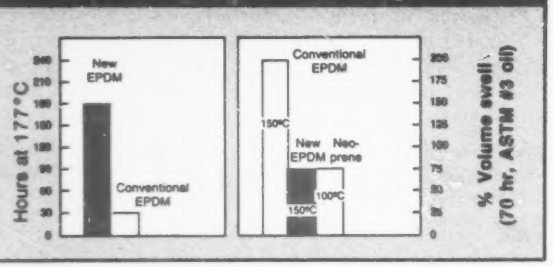
A related concern is the permeability resistance of elastomers to hydrocarbon fluids. Government regulations allow only a certain amount of hydrocarbons to escape to the atmosphere through evaporation. This places a new demand on elastomeric hoses.

Because of these new demands, alternate materials, such as plastics, are being considered for components currently made of elastomers. The rubber industry is being challenged to produce (1) new elastomer materials that will perform well in the new automotive environment and (2) new processes to make elastomers more economically competitive in order to maintain and expand its share of the automotive market. The challenge even extends to the development of new elastomeric components that will improve the durability or the performance of the automobiles. It is well known that many industrial and university laboratories have active research programs on designing new elastomer structures, understanding filler-elastomer interactions and developing thermoplastic elastomers that can be more easily processed than conventional elastomers. There is not enough time to cover all the significant work being carried out in the scientific community. Instead, this article will concentrate on only a few of the new demands being placed on automotive elastomer components and some of the research efforts at GM Research Laborities (GMR) being carried out to meet these challenges.

Examples of new requirements
Elastomers with improved high temperature performance
As it was mentioned earlier, the downsizing of the automobile resulted in higher underhood temperatures and created a need for high temperature fuel resistant as well as non-fuel resistant elastomers. The current high temperature elastomers including silicones, fluorocarbons and hydrogenated nitrile elastomers meet the needs for specific automotive applications, but they cannot be used for most applications because they are too expensive, and also, in some instances, they do not have all the required properties. From our prospective, as a user, there exists a gap between inexpensive general purpose elastomers, such as nitrile and EPDM, and expensive silicones and fluorocarbon elastomers. What we need now are general purpose elastomers that will be able to endure a 150°C projected underhood temperature for the lifetime of the vehicle.

An attempt towards meeting this goal was made at GMR. In one of our investigations aimed at the radiation curing of EPDM, we discovered an antioxidant system that can survive the free radical crosslinking of EPDM

Figure 1 — heat resistance measured as hours at 177°C for 50% retention of original elongation, and oil resistance measured as percent swell for new EPDM versus conventional EPDM



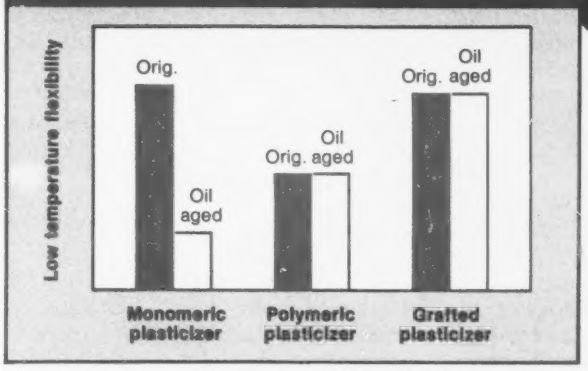
by radiation or by peroxide and produce an elastomer with vastly improved heat aging resistance[12]. The antioxidant system consisted of a hindered phenol, a metal oxide and a chlorinated hydrocarbon. When this system was used in an EPDM formulation containing a peroxide and a coagent as curatives, the heat resistance of the EPDM under the accelerated aging condition of 177°C improved from 30 hours for conventional EPDM to 180 hours (Figure 1). An added advantage was that the oil resistance of this new EPDM formulation also improved as shown in figure 1. The volume swell of the elastomer at 150°C in ASTM #3 oil was reduced from 200% for the conventional EPDM to only 75% for the new composition. This makes the oil resistance of the new formulation comparable to that of neoprene. Similar R&D efforts for further improvement of the heat resistance of EPDM and other elastomers are needed to meet the challenge of increased underhood temperatures.

Low temperature flexibility and oil resistance

In the automotive industry, oil resistant elastomers are essential materials used to fabricate parts such as grease and oil seals, boots, O-rings and hoses. Unfortunately, these elastomers have inherently poor low temperature flexibility, because the molecular structures which give rise to the oil resistance, also result in greater stiffness at low temperatures. Nitrile rubber, a widely used oil resistant elastomer, is a prime example. As the acrylonitrile content is increased, the swell in oil is reduced. This effect is accompanied by an increase in low temperature stiffness. Plasticizers are normally used to improve the low temperature flexibility. However, in the case of elastomers used for parts in contact with hydrocarbon fluids, these plasticizers are often leached out resulting in a loss of flexibility. Although the use of polymeric plasticizers improves permanence, they are not as effective as lower molecular weight materials. The inability of the two polymers to mix thoroughly prevents close contact between the polymeric plasticizer and the elastomer, thus reducing optimum effectiveness.

The challenge in this type of application is to develop oil and fuel resistant elastomers that will also perform satisfactorily at low temperatures, down to at least −40°C. We have attempted to meet this challenge by grafting side chains onto the polymer chain to provide plasticization[13,14]. It was discovered that grafting of 2-ethylhexyl acrylate onto nitrile rubber led to significant improvement in low temperature flexibility as shown in figure 2. The grafting was accomplished during the normal cure cycle of the elastomer, thus eliminating the need of an additional costly synthetic step.

Figure 2 — comparison of low temperature flexibilities of original and oil aged samples for nitrile elastomers plasticized with monomeric plasticizer, with polymeric plasticizer, and with grafted plasticizer



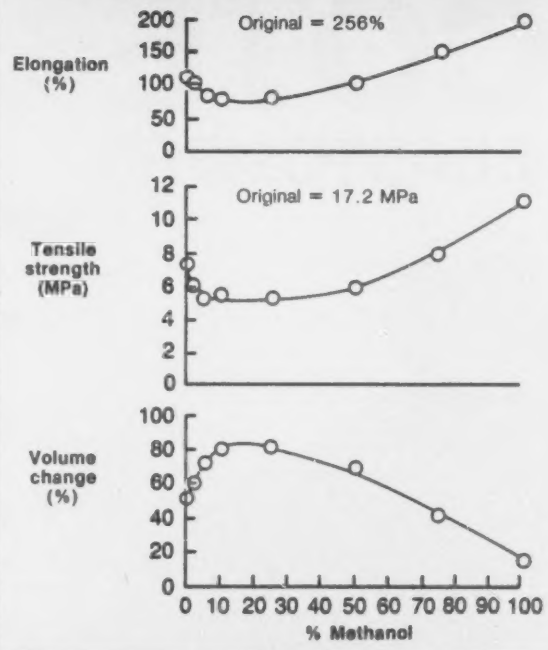
This method was shown to provide not only permanent plasticization, but also more than twice the effectiveness obtained by simple addition of a polymeric plasticizer. The improvement in flexibility was directly proportional to the amount of monomer employed. The structure of the monomer was also important in determining its effectiveness since variation in both the length and chemical composition of the ester side-chain led to changes in low temperature properties.

These results demonstrate that grafting is a feasible approach to developing elastomers which meet the challenge of having both oil resistance and low temperature flexibility. There may, however, be other approaches that can be used to reach the same goal.

Elastomers for fuel applications

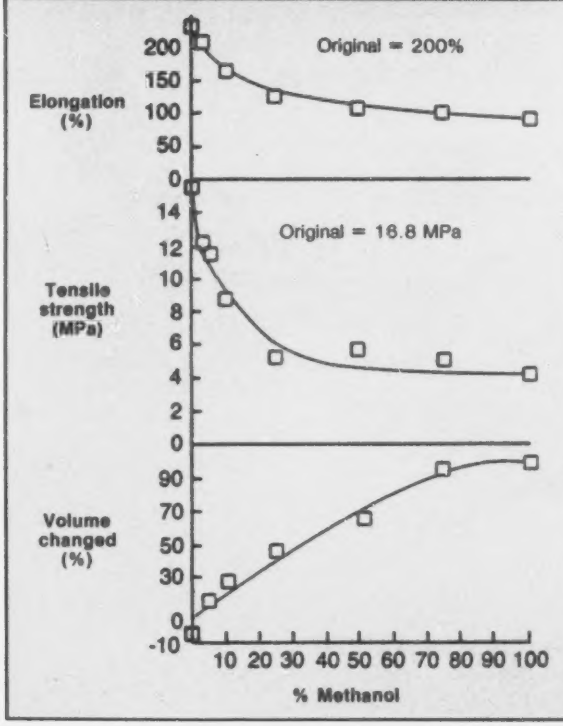
The challenge here is to develop elastomeric compositions that perform well in an increasing number of fuel blends. As was mentioned earlier, ethanol, methanol and methyl t-butyl ether, among other additives, are being blended into gasoline in order to improve the octane number or simply extend the gasoline. We have investigated the effects of these additives on the swell and tensile properties of elastomers[8,9,15]. It was found that in the case of fuel resistant elastomers exposed to alcohol-gasoline mixtures, the elastomer swell increases as the alcohol content of the gasoline is increased, reaching a maximum at alcohol concentrations between 10 to 40%, depending on the chemical structure of the elastomer. An example of our results is given in figure 3, showing the effects of increasing methanol concentration on volume change (swell), tensile strength and elongation of nitrile elastomer. Maximum swell of the elastomer occurs in a gasoline-methanol blend containing about 10% methanol. High swell of elastomers is undesirable not only because of dimensional instability but also because, as seen in the figure, it leads to a decrease in tensile strength and elongation. For most elastomers, the ultimate tensile and elongation values were found to be quantitatively related by simple linear equations to the volume fraction of the polymer in the swelled network. With the exception of fluorocarbon elastomer (in methanol-gasoline blends), the volume swell versus methanol concentration behavior, shown in figure 3, was observed for all fuel resistant elastomers exposed to both methanol-gasoline and ethanol-

Figure 3 — tensile elongation, tensile strength and volume change of nitrile elastomer after exposure to methanol/gasoline compositions



gasoline blends. The ethanol-gasoline blends are less severe than the methanol-gasoline blends in their effects on most fuel resistant elastomers. The results can be explained in terms of the solubility parameter concept. Fluorocarbon elastomers exhibited monotonic increase in swell with increase in methanol concentration as shown in figure 4. The maximum swell of about 100% occurred in pure methanol. The reason for the high swell was investigated using nuclear magnetic resonance (NMR) spectroscopy to determine the structure of methanol in pure form and in blends with polar and non-polar solvents. It was found that the hydrogen bonded structure of methanol is responsible for decreasing the overall solubility parameter of the alcohol to a valve equivalent to that of the fluorocarbon elastomers, thus causing the high swell.

Figure 4 — tensile elongation, tensile strength and volume change of fluorocarbon elastomer after exposure to methanol/gasoline compositions



The higher swell of the fuel resistant elastomers in alcohol-gasoline blends presents a challenge to develop new elastomers or new elastomer compositions that can withstand the more aggressive environment of the blends. Our response to this challenge was to develop a filler system that physically restricts swelling[18]. One promising approach is the use of platy fillers. These fillers form oriented plates in extruded elastomers. When elastomers containing platy fillers were exposed to swelling fluids, anisometric swelling was observed. A great deal of restriction in the swelling was seen in the plane of the oriented filler. If the filler is oriented in the critical dimension of the part, then the effective fluid resistance is improved. As seen in figure 5, the swelling restriction provided by talc in a nitrile elastomer formulation exposed to ASTM Fuel C is directly proportional to the volume fraction of the platy filler. This means that we can now control the dimensional stability of a fuel system elastomer part by simply adjusting the amount of platy filler without changing the chemical structure of the elastomer.

This approach provides solutions for certain elastomer parts exposed to fuel mixtures. Challenges and opportunities are still there for the development of other methods to make elastomer parts that will endure either gasoline-alcohol blends or pure alcohols. As most of you know, Brazil already uses 100% ethanol as automotive fuel. In the U.S., experimental fleets are currently running on methanol.

New or improved processing

The challenges in this area lie either in improving the current processing techniques to obtain better elastomer part performance or replacing current methods with faster, less expensive and/or less energy intensive

Figure 5 — effect of the volume fraction of platy filler on the swelling restriction of nitrile rubber

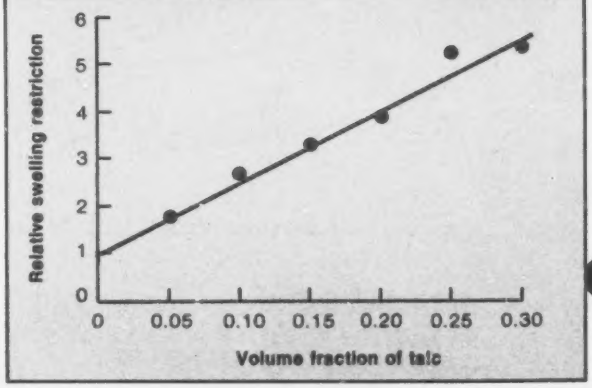


Table 2 — changes in properties of N330 carbon black after attrition

	Before attrition	After attrition
Particle size (A°)	260	150
pH	8.1	3.4
Critical surface energy of wetting γ_c (dyne/cm)	40.0	32.6

Table 3 — comparison of the properties at room temperature of carbon black reinforced polychloroprene obtained by the two mixing methods

Property	Cyclic mixing[a]	Conventional mixing[b]	Percent improvement (%)[c]
Tensile strength (MPa)	23.8	19.9	18.6
Ultimate elongation (%)	390	285	36.8
Fatigue life (cycle)	151,360	109,000	38.8
Permanent set (%)	0.90	3.25	72.3
Hysteresis at 100% elongation and room temperature	9.8	11.8	16.9
Freon-22 Permeability ($cm^4/s \cdot dyn$)	7.03×10^{13}	7.821×10^{13}	10.1

[a]Attrited N330 filled polychloroprene.
[b]N330 filled polychloroprene.
[c]Percent improvement (%) = [(a - b)/b] x 100%, where a = cyclic mixing and b = conventional mixing.

processes. The traditional processing of elastomers consists of three major operations: mixing, which is conducted normally in an internal mixer, followed by molding or extrusion into an article or part, and, finally, curing of the rubber article or part by chemical cross-linking of the matrix. Control of mixing of the ingredients is critical for obtaining uniform products with desired properties. Elastomers with the same composition can end up with different properties depending on the method and the degree of mixing. To improve the degree of mixing, we developed a mixing rule based on thermo-dynamic principles that takes into account not only the properties and amount of the ingredients in the formulation but also how they are mixed. Based on this rule, optimized conditions and procedures have been developed that lead to better distribution of the filler particles in the rubber matrix. The technique includes surface modification of the carbon black filler and a unique heating and cooling procedure for mixing the filler and rubber matrix[17,18]. The effect of attrition process on N330 carbon black is shown in table 2. In addition to smaller particle size, attrition (hot grinding) leads to a lower pH value for the slurry of the carbon black in water and a lower critical surface energy, γ_c. As a result, the interaction between this attrited filler and a polymer will be different. The ratio of surface energy of attrited N330 carbon black to that of neoprene is 1.03 as compared to 1.30 for the unattrited N330 black. This means that the attrited black is more compatible with neoprene.

The new mixing technique involves heating and cooling mixing cycles in a Banbury internal mixer or on a two-roll mill as shown in figure 6. The heating cycles are aimed at decreasing the microvoid concentration and enhancing polymer-filler adhesion, and the cooling cycles are aimed at improving the degree of mixing by shear stresses generated during mixing at lower temperatures. Better filler distribution and lower void concentration are observed in the case of the new mixing technology as compared to the conventional mixing. As a result, improvement in properties, such as tensile strength, ultimate elongation, fatigue life, permanent set and permeability, is obtained due to the improved mixing as shown in table 3. Perhaps the most significant is the improvement in the dynamic properties at low temperatures. Figure 7 shows the dynamic mechanical analysis (DMA) data of a neoprene (polychloroprene) composition mixed by two different methods. The glass transition for both samples is −37°C. However, the temperature sensitivities of the storage modulus of the two systems are quite different. The storage modulus of the conventionally mixed neoprene remains constant down to 40°C and then gradually increases as the tem-

Figure 6 — mixing temperatures on a two-roll mill using the cyclic mixing procedure

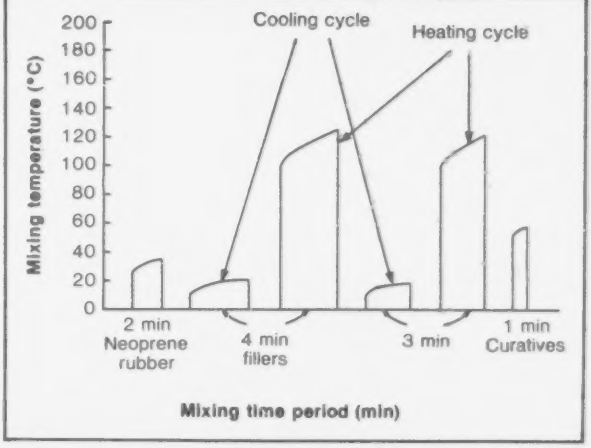
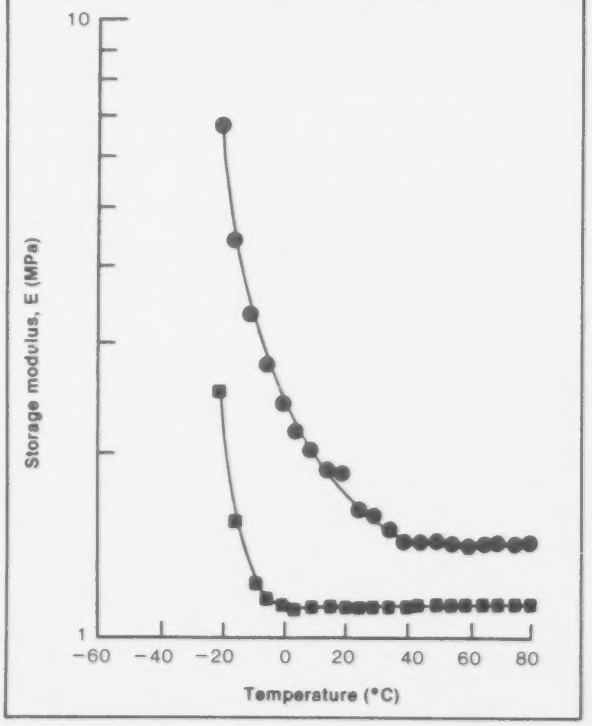


Figure 7 — storage modulus as a function of temperature for both the conventionally mixed (•) and the cyclically mixed (■) polychloroprene compositions



perature decreases and the polymer approaches the glassy state. In contrast, the storage modulus of the cyclically mixed neoprene remains constant down to −10° and then sharply increases to its glassy state value as the temperature decreases. In other words, through better mixing, the neoprene has better low temperature properties and less temperature sensitivity. Automotive suspension system components, such as the jounce bumper, could thus be designed using the improved mixed neoprene to provide the required energy absorption and spring rate and maintain these properties over a broader temperature range.

Improvements are also desired for the other two steps of elastomer processing, namely, molding and curing. The development of injection moldable elastomers and thermoplastic elastomers that have the required properties for automotive applications will lead to appreciable savings in time and energy and to less costly products. Also, microwave radiation can lead to savings in energy and even improved properties when used for the curing of specially designed formulations. Additional research is needed in all these areas to bring about the development of new and/or improved products and processes for use in the automotive industry.

Other challenges and opportunities

A few additional examples will be mentioned with regard to the potential needs of the automotive industry for specialty elastomers. These include conductive elastomers for new battery applications and for shielding of electronic circuits and dissipation of static charges. There is also a need for high strength oriented elastomer filaments and sheets for the purpose of energy storage and handling. However, the most pressing need is improved quality control during polymer synthesis to produce elastomers with consistent and uniform properties, i.e., the same molecular weight and molecular weight distribution, the same degree of branching, etc.

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C5175-14

Rubber World

The technical service magazine for the rubber industry

Volume 194, No. 2

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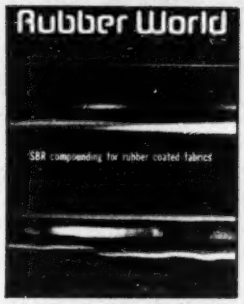

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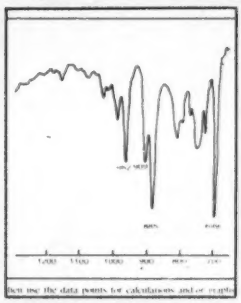

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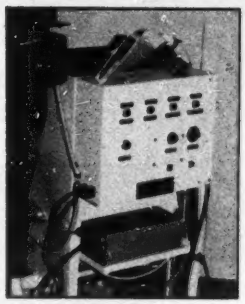

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Business Briefs

Acquisitions, expansions

Degussa AG, West Germany, has agreed to purchase most of the European carbon black business of **Phillips Petroleum.** The transaction includes Phillips' wholly owned companies in Botlek, Netherlands and Bordeaux, France as well as Phillips' 50% interest in carbon black companies in Malmo, Sweden; Bristol, U.K.; Ravenna, Italy and Port Elizabeth, South Africa. The capacities of these six plants is approximately 330,000 tons per year. Phillips recently sold its Borger, TX facility to Sid Richardson Carbon and is looking for buyers for its Orange, TX plant and its minority interests in operations in Mexico and India.

BFGoodrich sold subsidiary **Continental Conveyor & Equipment** to **Nesco, Inc.,** Cleveland, OH an international privately held corporation. Continental has its headquarters and a manufacturing plant in Winfield, AL and plants in Sherman, TX and Salyersville, KY.

Polyvinyl Chemicals Inc. is constructing a 10,000 sq. ft. addition to its research and development facilities in Wilmington, MA. When completed this summer, the new building will house three labs for synthesizing special-purpose acrylic and urethane polymers and four for developing new applications for paints and coatings.

Contracts, licenses

Synthetic Products appointed **Summit Chemical** as sales agent for its line of custom rubber dispersions in the far midwest and southwest.

Parker Hannifin established a joint venture company with **Tong Yang Chemical,** Pusan, ROK, to produce a line of industrial hoses and connectors in a plant previously owned by Tong Yang.

Paul-Monroe Fluidpower agreed to market the **Goodyear** Insta-couple product line in California.

Bekaert S.A. and the wire products division of the **BHP Steel International Group of Australia** formed a joint venture company in Geelong, Victoria to manufacture steel tire cord in Australia.

LC Finishing Equipment, Redwood City, CA will handle the custom rubber product line of **Lonstroff-BTR** of Switzerland in the United States.

Air Products acquired the exclusive rights to manufacture and sell certain **BASF** acrylic polymer emulsions for pressure sensitive adhesive applications in North America. Air Products also entered into a joint venture to manufacture barrier-treated, high-density polyethylene fuel tanks for the North American automotive industry with **Kautex Werke Reinhold Hagen AG** and **Peerless-Cascade Plastics Ltd.** of Canada.

Resinall Corp. appointed **H.M. Royal** as west coast representative for its line of hydrocarbon and rosin based resins.

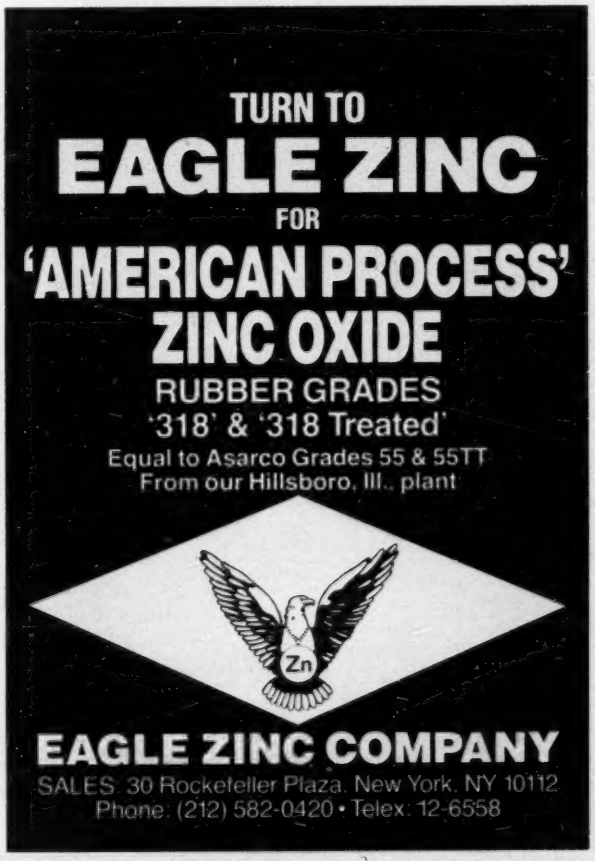
Ribelin Sales has agreed to distribute the **Schold Machine** line of dispersers, co-axial dispersers and shot mills throughout the southwest.

Financial statements

Asarco reported a net loss for 1985 of $62.1 million. In-

RMA tire shipments & production report through January 1986 (figures in thousands of units)

Passenger Tires	YTD 1985	YTD 1984	% Change
Shipments			
Original Equipment	5,000	4,920	+1.63
Radial	4,178	4,116	+1.51
Replacement	10,896	11,208	−2.78
Radial	9,266	9,238	+0.30
Export	341	554	−38.45
Radial	242	446	−45.74
Total	16,237	16,682	−2.67
Radial	13,686	13,800	−0.83
Production	13,422	14,971	−10.35
Radial	11,324	11,807	−4.09
Ending Inventory	32,630	34,207	−4.61
Radial	27,491	26,887	+2.25
Truck & Bus Tires			
Shipments			
Original Equipment	603	619	−2.58
Radial	388	390	−0.51
Replacement	2,470	2,540	−2.76
Radial	1,134	1,041	+8.93
Export	97	124	−21.77
Radial	57	59	−3.39
Total	3,170	3,283	−3.44
Radial	1,579	1,490	+5.97
Production	2,884	3,410	−15.43
Radial	1,339	1,413	−5.24
Ending Inventory	8,087	7,741	+4.47
Radial	4,131	3,483	+18.60



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come was $107.7 million.

Ausimont Compo reported 1985 revenues of $385.2 million with a net income of $25.9 million.

BASF Corp. earnings before taxes were $68.9 million in 1985 on sales of $2.6 billion.

Bekaert reported earnings of BEF 3,085 million on a consolidated turnover of BEF 44,896 million in 1985.

Blasius Industries had third quarter net earnings of $398,000 on sales of $10.6 million.

Degussa reported 1985 fiscal year profits of 112 million DM on sales of 11,714 million DM.

Du Pont reported 1985 net income of $1.1 billion on sales of $29.4 billion.

Eagle-Picher had first quarter sales of $162.4 million and net income was $7.8 million.

Gates Corp. reported sales of $1.1 billion for 1985.

GenCorp had a first quarter net income of $18.7 million on sales of $614 million.

Goodyear Canada reported 1985 net income of $144,000 on sales of $632.1 million.

Park Ohio had a 1985 net income of $6.9 million on sales of $186.1 million.

Rubbermaid Inc. reported net earnings for the first quarter of $15.7 million on sales of $185 million.

Markets, news

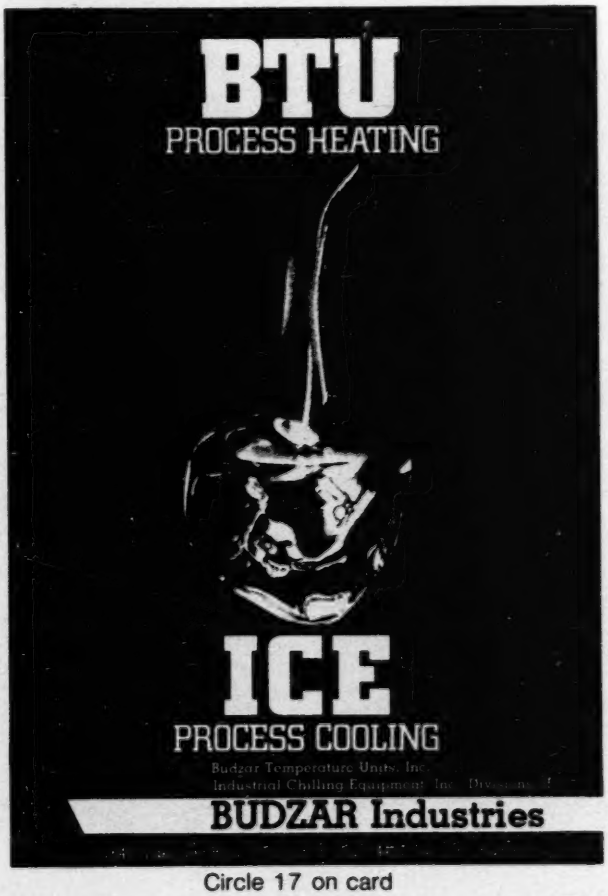
Domestic shipments of furnace carbon black by U.S. producers dropped nearly 11% in 1985 to 2.47 billion pounds according to a report by J.M. Huber Corp. This percentage decline was about equal to the increases experienced in each of the previous two years. The turning point actually occurred in mid-1984 and has continued unabated since. Total volume shipped decreased each quarter throughout 1985. It appears that the magnitude of the decline was exacerbated by lower inventories and some late 1984 prebuying by consumers, Huber says. The cycle may be nearing its low point, however, estimated 1986 demand is expected to be slightly lower than last year.

The percentage of hard, or tread, blacks of total black shipped increased to 56.4%, roughly one point higher than the previous two years. Part of this shift is a recognized result of tire compound changes. It also indicates that the drop in nontire rubber products manufacture exceeded that of tire producers. The decline in soft black usage exceeded 12%, whereas hard blacks were off by less than 10%. The adverse impact of tire imports continued to grow. Automotive tire shipments were down by a mere 0.2% but production decreased by 6.4%, according to RMA figures. Imported tires as a percent of replacement tire shipments grew from 20.8% in 1984 to 23.4% last year. In terms of carbon black, those imported passenger car and truck tires brought in 315 million pounds, 12.5% more than during 1984.

Both imports and exports of carbon black declined last year, imports by 9% and exports by 11%. The net import trade balance (based on volume), however, improved a bit to 74 million pounds from 1984's 81 million pounds. Canada and Mexico were the source of 133 million pounds and 95 percent of imported black. With the drop in black demand, the carbon black industry's average operating rate declined last year to 75%. Over the past six years, the operating rate exceeded 80% only once, and it has not reached 85% since 1978. As with the tire and other in-

Carbon black industry in the U.S.A. (metric tons)

		1985 Year	Percentage Change Year '85 vs. Year '84
N-100 (SAF)	Prod.	29,167	+11.1%
	Ship.	27,675	+ 4.6%
N-200 (ISAF)	Prod.	133,713	− 7.9%
	Ship.	130,341	− 9.4%
N-300 (HAF)	Prod.	502,818	−11.2%
	Ship.	497,767	− 9.8%
N-500 (FEF)	Prod.	101,385	−10.1%
	Ship.	99,961	− 8.1%
N-600 (GPF)	Prod.	286,559	−13.9%
	Ship.	283,832	−13.9%
N-700 (SAF)	Prod.	110,596	−12.6%
	Ship.	109,634	−11.3%
Total	Prod.	1,166,238	−11.1%
	Ship.	1,149,211	−10.5%
Domestic Shipments (Included Above)		1,118,802	−10.8%
Domestic Share		97.4%	



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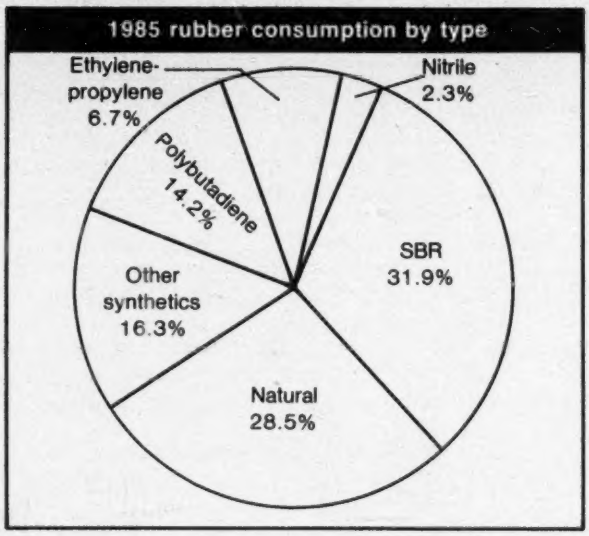

RMA rubber report through January 1986 (figures in metric tons)

	Cumulative 1986	Cumulative 1985	% Change 86 vs 85
New Rubber			
New rubber available	254,400	265,263	-4.10
Imports	87,881	90,657	-3.06
Exports	28,734	27,943	2.83
Apparent Consumption	220,093	233,039	-5.56
Natural Rubber			
Imports	64,661	72,782	-11.16
Exports	3,449	3,067	12.46
Apparent Consumption	59,431	72,098	-17.57
% Total new rubber	27.00	30.93	
Synthetic Rubber			
Production	166,519	174,606	-4.63
Imports	23,220	17,875	29.90
Exports	25,285	24,876	1.64
Apparent Consumption	160,662	160,940	-.17
% Total new rubber	72.99	69.06	
SBR			
Production	67,892	78,738	-13.77
Imports	8,909	5,464	63.05
Exports	6,978	6,531	6.84
Apparent Consumption	73,089	70,567	3.57
Nitrile			
Production	4,628	5,484	-15.61
Imports	858	1,167	-26.48
Exports	782	676	15.68
Apparent Consumption	5,249	5,140	2.12
Polybutadiene			
Production	30,249	29,382	2.951
Imports	4,880	4,288	13.81
Exports	3,750	1,474	154.41
Apparent Consumption	30,444	31,706	-3.98
Ethylene-Propylene			
Production	17,698	17,550	-.84
Imports	160	179	-10.16
Exports	3,101	2,732	13.51
Apparent Consumption	14,643	16,270	-10.00
Butyl, Polychloroprene, Polyisoprene, Silicone and other Synthetic Elastomers			
Production	46,052	43,453	5.98
Imports	8,413	6,777	24.14
Exports	10,674	13,463	-20.72
Apparent Consumption	37,238	37,258	-.05

dustries, there is substantial excess carbon black production capacity in this country. Based on a review of probable demand for the next five years, there is at least 300 million pounds of annual nameplace capacity, which could be retired from service without disrupting the industry's ability to meet market demand. This is nine percent of current capacity.

Consumption of most types of rubber were down for January, continuing a slide that began in 1985. Gains were posted for SBR and nitrile of 3.5% and 2.1% respectively, while the others posted declines. In 1985 total consumption of rubber was off almost 6.5%. Natural rubber consumption increased slightly while synthetic rubber decreased 8.8% to 1.88 million metric tons Rubber Manufacturers Association figures show. SBR remained the dominant rubber, accounting for almost 32% of all rubber used.

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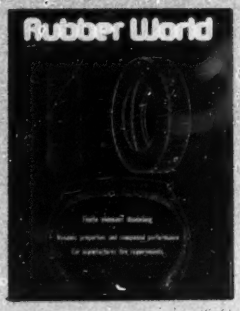

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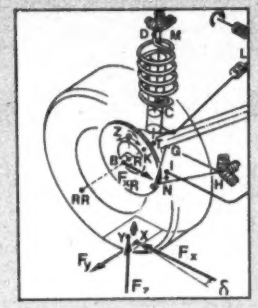

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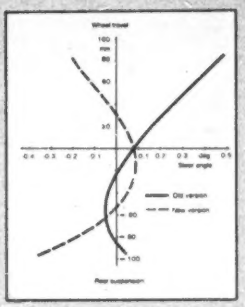

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Acquisitions, expansions; contracts, licenses; financial statements; markets, news.

12 Tech Service: Developing a new picture
by Jon Menough, contributing technical service editor. Finite element modeling has gained popularity with tire manufacturers and many customize the program to their needs.

14 Quality Management: Get the bugs out
by David Crosby, Crosby & Co. Every workplace has bugs (problems) and needs a systematic approach to eliminate them.

16 Urethane Forum: The hazard communication program
by Bill Stahr, Brad & Associates. The Federal Hazard Communications Program went into effect in late May but the key to successful implementation is getting the employee to better understand workplace hazards.

19 Tire requirements from the car manufacturer's point of view
by E. Muller, Audi AG. Author looks at the roadability of the car as influenced by the chassis with emphasis on the role of the tire in playing a decisive part in enabling the chassis to fulfill its proper function.

25 Dynamic properties and compound performance
by John M. Funt, Cabot Corporation. Key steps in the manufacture of tires and the performance characteristics of tires on the road can be analyzed by mathematical techniques to evaluate compound performance. Author discusses some key processes to highlight this approach to compound evaluation.

36 Cost savings through standard target values
by John S. Dick, BFGoodrich Tire Group. This article looks at the cost savings that can be realized through the establishment of standard target values for carbon black by ASTM Committee D-24 on Carbon Black.

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edited by Bob Samples, Akron Rubber Development

40 Technical Focus
by David Given, technical editor

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Cover photo courtesy of Cooper Tire

A Lippincott & Peto Publication

Business Briefs

Acquisitions, expansions

Avery Inc. has agreed to buy the **Uniroyal Chemical Co.** for $760 million. Included in the sale are the rubber chemical, polyurethane, and elastomer tradenames along with the Naugatuck, CT and Geismer, LA chemical facilities, the Painesville, OH elastomers plant and plants in the U.K., Italy, Brazil, Mexico and Taiwan.

3M completed a multimillion dollar addition to the company's chemical plant at Antwerp, Belgium doubling its capacity for fluoroelastomer production. The company also announced it has concluded an agreement with **Hoechst AG**, Frankfurt, FRG under which Hoechst will manufacture certain fluoroelastomer latexes for 3M.

Du Pont announced developments in Japan, Europe and the U.S. that will boost its position as a producer of fluoreelastomers. In Japan, Du Pont-Showa Denko is constructing a precompounding facility at the Kawasaki Works near Tokyo. Du Pont de Nemours began production of its fluoroelastomer plant at the Dordrecht Works in the Netherlands which nearly doubles the Du Pont's worldwide capacity of its Viton fluoroelastomer to more than 10 million pounds per year. In the U.S. the company plans to upgrade its finishing facilities at the Chamber Works in Deepwater, NJ.

Sheller-Globe Corp. acquired the business and assets associated with **United Technologies'** extruded sponge rubber weatherstripping product line for cars and trucks. The purchase includes extrusion and related equipment from UT's St. Louis, MO plant which will be transferred to Sheller-Globe's Keokuk, IA facility.

RMA tire shipments & production report through February 1986 (figures in thousands of units)

Passenger Tires	YTD 1986	YTD 1985	% Change
Shipments			
Original Equipment	9,754	9,264	+5.29
Radial	8,157	7,740	+5.39
Replacement	19,996	19,621	+1.90
Radial	17,168	15,768	+8.88
Export	689	1,184	−41.81
Radial	503	948	−46.94
Total	20,439	30,069	−32.03
Radial	25,828	24,458	+5.61
Production	26,675	29,298	−8.95
Radial	22,447	23,138	−2.99
Ending Inventory	—	—	—
Radial	—	—	—
Truck & Bus Tires			
Shipments			
Original Equipment	1,171	1,202	−2.58
Radial	763	760	+0.39
Replacement	4,538	4,515	+0.51
Radial	2,075	1,800	+15.28
Export	223	260	−14.23
Radial	132	134	−1.49
Total	5,932	5,977	−0.75
Radial	2,970	2,694	+10.24
Production	5,597	6,460	−13.36
Radial	2,615	2,733	−4.32

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Circle 6 on card

Business Briefs

Akron Chemical completed construction on a $100,000, 1,600 square foot addition at its Akron headquarters.

Parkway Products is constructing a $1.5 million, 30,000 square foot facility in Erlanger, KY to manufacture rubber products from composites and specialty elastomers.

National Starch & Chemical has acquired Adhesives Pte, of Singapore; Adhesives Sdn. Bhd of Malaysia and Adhesives Ltd. of Thailand from **ACI International, Ltd.** of Australia.

BP Chemicals is building a compounding unit at its Antwerp Belgium facility for the production of new-generation semi-conductive polyethylene compounds for wire and cable applications. The unit is scheduled to be completed by the end of 1986.

Arco Chemical will increase propylene glycol capacity in a $20 million expansion and modernization program at its Bayport, TX plant.

Union Carbide is increasing silicone surfactant and silicone polymer production capacity at its Sisterville, WV plant by 35%.

RMA rubber report through February 1986 (figures in metric tons)

	Cumulative 1986	Cumulative 1985	% Change 86 vs 85
New Rubber			
New rubber available	508,229	526,948	-3.93
Imports	181,328	186,622	-2.84
Exports	62,324	56,200	10.90
Apparent Consumption	438,661	477,003	-8.04
Natural Rubber			
Imports	140,222	145,611	-3.70
Exports	7,220	6,772	6.62
Apparent Consumption	130,884	137,843	-5.05
% Total new rubber	29.83	28.89	
Synthetic Rubber			
Production	324,901	340,326	-4.53
Imports	41,106	41,011	.23
Exports	55,104	49,428	11.48
Apparent Consumption	307,776	339,160	-9.25
% Total new rubber	70.16	71.10	
SBR			
Production	134,228	151,195	-11.22
Imports	15,023	13,667	9.92
Exports	15,549	14,266	8.99
Apparent Consumption	137,906	146,956	-6.16
Nitrile			
Production	9,375	10,138	-7.53
Imports	1,844	2,757	-33.12
Exports	1,887	1,331	41.77
Apparent Consumption	10,149	11,147	-8.95
Polybutadiene			
Production	59,877	59,362	.87
Imports	8,491	10,590	-19.82
Exports	5,032	3,791	32.74
Apparent Consumption	58,919	71,227	-17.28
Ethylene-Propylene			
Production	33,876	36,344	-6.79
Imports	627	232	170.26
Exports	6,795	4,630	40.68
Apparent Consumption	29,475	31,868	-7.51
Butyl, Polychloroprene, Polyisoprene, Silicone and other Synthetic Elastomers			
Production	87,544	83,287	5.11
Imports	15,121	13,765	9.85
Exports	25,841	25,210	2.50
Apparent Consumption	71,323	77,962	-8.52

**Latest figures available to RMA indicate INRO Stocks included in natural rubber consumption figures to be 16,952 for the year 1985, and 0 for 1986 as of February.*

Contracts, licenses

Polysar appointed **Harwick Chemical**, Akron, OH as a distributor for its synthetic rubbers in the midwest.

Standard Products, Cleveland, OH and **Nishikawa Rubber**, Hiroshima, Japan have entered a joint venture for the manufacture of sponge and dual durometer door and trunk seals in the U.S. with the parts to primarily supply the Japanese auto manufacturers in North America. Nishikawa is also licensing Standard to manufacture rubber window channels, weatherstrips and vinyl trims designed and engineered by Nishikawa for sales to Japanese

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The technical service magazine for the rubber industry

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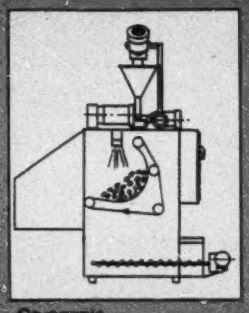

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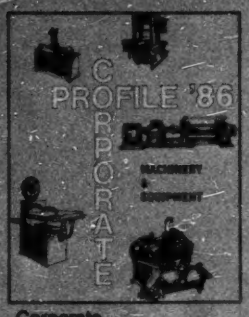

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12 Tech Service: Processing TPR
by Jon Menough, contributing technical service editor. Processing thermoplastic elastomers is quite different than traditional rubbers and requires the rubber processor to look at the material from a totally different perspective.

14 Quality Management: The personal computer and quality management.
by David Crosby, Crosby & Co. If a quality department has more than one person, it should have a personal computer. Article describes what is needed by way of hardware and software.

18 Urethane Forum: 1986 spring PMA meeting
by Bill Stahr, Brad & Associates. A look at the recent PMA meeting and what was presented.

20 Rubber processing equipment trends
by Walter Rapetski, Farrel Co. Author looks at the trends in rubber processing equipment and discusses the batch mixer, continuous processors and controls. These areas offer the best hope for the improvements necessary to reduce the cost of processing rubber compounds.

24 Economic comparison of cryogenic blast deflashing equipment
by Rolf Wieland, MG Industries. Several cryogenic blast deflashing systems were evaluated under normal production conditions at the facilities of two rubber companies. This article looks at the economic comparison to determine the economic differences, if any.

27 Important factors in the design of molds
by Donald N. Rales, Rales and Associates. The basic factors involved in the design of a mold for commercially producing rubber products, problems encountered, how they are handled and how the producer can aid the designer in getting a better mold design are discussed by the author.

33 Programmable controllers and dedicated microprocessors provide improved machine controls
by Tom Schurr, Independent Digital Consulting, Inc. Article compares programmable controllers and dedicated microprocessor controllers with the older style relay and electronic controls and tells what to look for when making the decision to replace the older style instrumentation.

36 Used and rebuilt machinery suppliers
Directory of second hand rubber processing equipment along with a grid showing rebuilding capabilities.

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Directory of instrumentation and testing equipment suppliers to the rubber industry.

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Cover photo courtesy of Chrysler Corp., Amplex Division

A Lippincott & Peto Publication

Business Briefs

Contracts, licenses

Polysar has formed a joint venture with **Shanghai Gao Qiao Petrochemical Corp.** of China. In the first phase of the agreement Gao Qiao will use Polysar technology to triple the capacity of its 1,000 metric ton latex plant. Polysar technology will also be used to construct a 10,000 metric ton latex plant during the second phase.

PPG Industries will provide technology and equipment for a 10,000 metric ton silicas plant in China in Nanchang.

Alkar Inc. has formed a joint venture with **ROC Associates** to offer remanufactured tire presses with an advance control system.

Armature Coil Equipment, Cleveland, OH appointed Eric Sheard of **Lescon, Inc.**, Flemington, NJ distributor for its rubber and polymer stripping oven in the eastern U.S.

The General Polymers division of **Ashland Chemical** has been selected to distribute **Dow Chemical's** line of Pellethane thermoplastic polyurethane resins.

Martin Marietta and **Dow Chemical** said they will explore potential alternative business approaches in the specialty chemical field rather than pursue the previously announced effort to form a joint venture.

Dock Resins appointed **Jensen-Souders Associates**, Itsaca, IL as a sales representative.

Littleford Bros., Florence, KY was appointed by **Papenmeier GmbH** of West Germany as the exclusive representative for all parts and service requirements for its high-intensity mixers and coolers.

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Financial statements

Asarco had a net loss of $29.1 million in the first quarter on sales of $291.6 million.

Ausimont Compo has a first quarter net income of $11 million on sales of $145.2 million.

Cabot Corp. reported second quarter net income of $17.6 million on sales of $340.1 million.

Eagle-Picher announced second quarter net income was $10.1 million on sales of $172.2 million.

Englehard Corp. reported net earnings for 1985 were $42.6 million on sales of $2.2 billion.

Firestone reported net income for the second quarter

RMA rubber report through April
(figures in thousands)

	YTD 1986	YTD 1985	%change
New Rubber			
new rubber available	1,093,841	1,085,971	.7
imports	394,650	387,515	1.8
exports	132,268	120,863	9.4
apparent consumption	927,869	925,038	.3
Natural rubber			
imports	302,524	300,066	.8
exports	14,635	13,432	8.9
apparent consumption	294,472	291,043	1.2
Synthetic rubber			
production	696,991	696,466	.1
imports	92,126	87,450	5.3
exports	117,653	107,431	9.5
apparent consumption	643,415	643,995	–.1
% new rubber	69.34	69.61	
SBR			
production	281,106	300,975	–6.6
imports	37,204	28,250	31.2
exports	30,718	29,287	4.8
apparent consumption	281,379	293,566	–4.1
Nitrile			
production	20,301	21,543	–5.7
imports	3,832	4,649	–17.5
exports	3,185	2,474	28.7
apparent consumption	21,652	21,499	.7
Polybutadiene			
production	122,618	119,921	2.2
imports	18,345	22,420	–18.1
exports	8,478	7,923	7.0
apparent consumption	119,635	136,656	–12.4
Ethylene-Propylene			
production	76,832	78,167	–1.6
imports	1,511	329	359.2
exports	15,891	10,087	57.5
apparent consumption	62,668	64,410	–2.7
Butyl, Polychloroprene, Polyisoprene, silicone and other synthetic elastomers			
production	196,047	177,850	11.3
imports	31,234	31,702	–1.4
exports	69,383	57,660	2.9
apparent consumption	158,083	127,863	23.6

Business Briefs

of $12 million on sales of $868 million.

GenCorp had a net income of $37 million for the second quarter on sales of $755 million.

NL Industries posted a net income loss of $1 million with net sales of $359.2 million.

Markets, news

Although world tire demand is projected to lag behind general economic growth, many opportunities exist for innovative, aggressive companies, especially in the developing nations according to a study by The Freedonia Group, Cleveland, Ohio. The study projects gains for all-season tires, run-flat tires, the twin-tire concept and liquid injection molded tires. *World Rubber and Tire Markets* sees a shift in OEM tire demand which will mirror the geographical production of automobiles and trucks shift to countries such as Brazil and South Korea. Tire production will parallel aggregate tire demand with most of the increased supply arising from Japan, South Korea and several of the developing countries. By the late 1980s, South Korea firms will emerge as formidable competitors in the international market as technological innovations in manufacturing will allow economies of scale to be reached at less than 2,000 tires per day, compared to current levels of 6,000 tires per day. TFG sees this latter development as promoting tire manufacturing in various national markets that were previously thought to be too small. This will cause some of the majors to pull out of some markets but the tire markets will still be dominated by about 10 multinational companies. The study sees Goodyear and Michelin remaining the premier tire companies followed by Bridgestone, Sumitomo Rubber and Continental Gummi-Werke.

RMA tire report through April
(figures in thousands of units)

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Keeping *you* informed means keeping *us* informed. To report to you the latest in rubber industry happenings, the editors of Rubber World rely on many sources of information. One of our most important sources is you, our reader.

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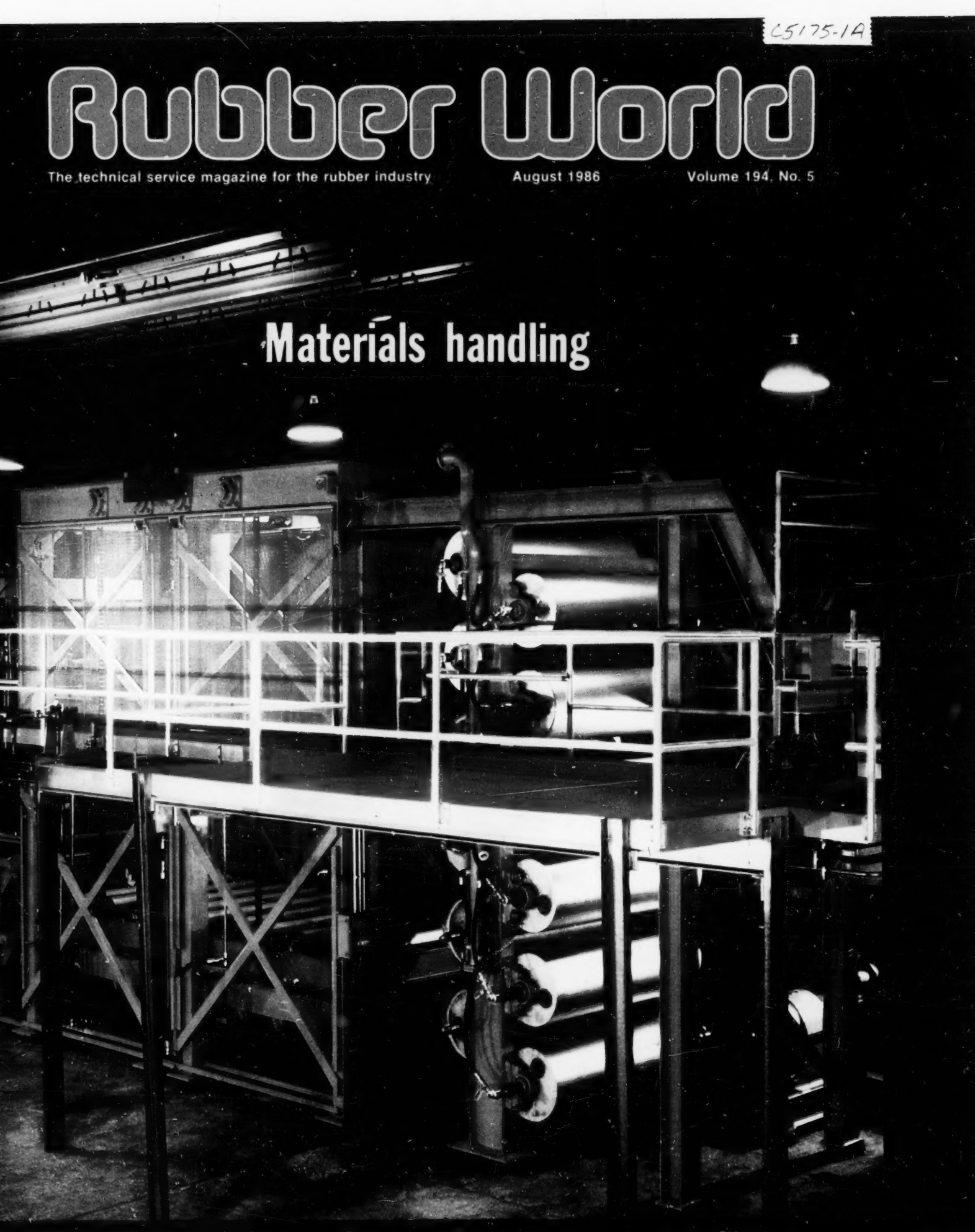
Rubber World

The technical service magazine for the rubber industry August 1986 Volume 194, No. 5

Materials handling



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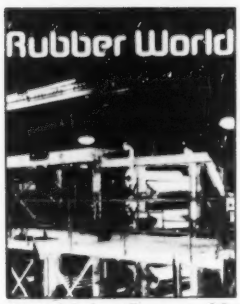

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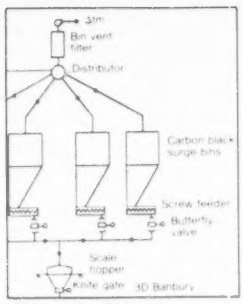

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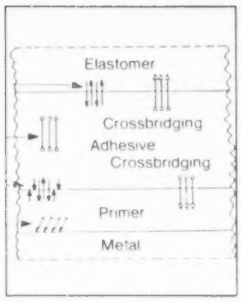

Elastomer/metal adhesion p. 29

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Acquisitions, expansions; contracts, licenses; financial statements; markets; news

14 Tech Service: A tetra-kaidecahedron?
by Jon Menough, contributing technical service editor. Cork is an engineering material with a number of unique and intriguing properties and is often overlooked by rubber compounders in applications where it would provide significant benefits.

16 Quality Management: Suppliers and quality improvement
by David Crosby, Crosby & Co. A look at the reasons why supplier-supplied quality is such a problem to many.

18 Urethane Forum: Sprayable polyurethane
by Bill Stahr, Brad & Associates. The uses of sprayable urethane are virtually unlimited but it is not the panacea for all applications. A look at what is to be considered for this type of process.

20 General materials handling and unique application solutions
by Ron Cain and Jim Hawk, ACC Automation. Article discusses general materials handling and reviews unique application solutions that can be accomplished by piecing together standard components that are in every day use in plants.

25 Automatic carbon black systems for mechanical goods rubber compounding
by Vincent A. DeLuca, Jr., Jones & Ross, Inc. Author looks at the rationale for choosing a dense phase carbon black conveying system when automating a rubber mixing facility.

29 Effect of compounding ingredients on elastomer to metal adhesion
by M.A. Weih, C.E. Siverling and F.H. Sexsmith, Lord Corporation. This article discusses the relationship between compounding ingredients and post-vulcanization adhesion, in particular, carbon black type and level, and the cure system in natural rubber bonded to phosphatized steel.

36 Colloidal silica for rubber reinforcement
by C.C. Payne, Nalco Chemical Company. Author describes N-1115 colloidal silica which can be added to SBR rubber latex eliminating the need for energy-intensive mixing equipment to get the necessary reinforcement.

43 Patent News
edited by Bob Samples, Akron Rubber Development

45 Technical Focus
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New equipment, instruments, CAD/CAM, products and materials

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Cover photo courtesy of ACC Automation

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Business Briefs

Acquisitions, expansions

Monsanto is building a plant in Brazil for its thermoplastic rubber and elastomer compounds and is building another in Japan as part of a joint venture with **Mitsubishi Chemical**. Both facilities will start up in mid 1987 and bring the company's capacity to near 100 million pounds for its Santoprene and Geolast lines.

Amoco Chemicals has acquired the engineering polymers and advanced composites businesses of **Union Carbide**. The product lines include Udel polysulfone, Midel engineering resins, Radel polyarylsulfone, Ardel polyarylate, Kadel polyketone and Thornel carbon fibers and advanced composite systems. Included in the business units is an engineering polymers plant in Marietta, OH and a composites operation in Greenville, SC.

Morenci Engineered Rubber Products has opened a 25,000 sq. ft. plant in Kendallville, IN to produce injection molded rubber components primarily for the auto industry that will employ 60-80 persons when fully operational.

Fluorocarbon Co., Laguna Nigel, CA acquired the rubber bearing pad business of **Oil States Industries**, Athens, TX for approximately $3 million.

Buckhorn, Inc. is adding nearly $1 million worth of injection molding equipment at its Hannibal, MO plant that will eventually produce thermoplastic original equipment parts for commercial vehicles.

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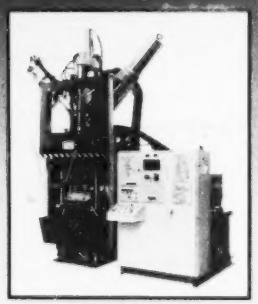

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Chem-Trend is constructing a three-building complex in Howell, MI which will include an administration building, a laboratory and a 25,000 sq. ft. production facility that will be used to manufacture most of its release agents.

Sterling Tire, Tuscumbia, AL purchased **Bearcat International Tire**, Dublin, Ireland and both companies will operate as divisions of the newly formed First Tire Inc. First Tire will produce and market all types of industrial tires.

Exxon Chemical Americas has started up an expansion of its neo acids facilities at its Baton Rouge, LA site. The expanded plant will continue to produce neo-pentanoic and neo-decanoic acids and will produce two new grades, neo-heptanoic and neo-nonanoic acids.

Dura Commodities, Harrison, NY, the U.S. affiliate of Astor Chemical has changed its name to Astor Wax Corp. **Astor Chemical** acquired **Trans Penn Wax**, Titusville, PA.

Technet, an engineering consulting firm specializing in rubber and plastic extrusion solutions has been formed in Needham, MA. It will provide contract engineering services for the wire and cable and fiberoptic industries.

QO Chemicals has completed the first half of a two-phase plant expansion at its Memphis, TN polytetramethylene ether glycol facility increasing production capacity by 20% that will be expanded a total of 40% by January.

Teknor Apex, Pawtucket, RI purchased **RPC, Inc.**, Harbor City, CA a manufacturer of colorants and specialty compounds.

Flexel, Atlanta, GA has acquired the cellophane business and the Tecumseh, KS plant from **Du Pont**.

Carlisle Companies has agreed to buy **Data Electronics**, San Diego, CA a manufacturer of magnetic tape data cartridges and other data communications products.

Liquid Carbonic is building a 600-ton/day air separation plant in Stockertown, PA to begin operation in the fourth quarter of 1987.

Magnesium Elektron Ltd. recently commissioned a new zirconium chemicals solutions plant at Swinton,

RMA tire shipments & production report through May 1986 (figures in thousands of units)

Passenger Tires	YTD 1986	YTD 1985	% Change
Shipments			
Original Equipment	24,194	24,383	−78
Radial	20,251	20,291	−2
Replacement	54,376	55,119	−1.35
Radial	46,471	44,392	4.68
Export	1,617	2,509	−35.55
Radial	1,237	2,030	−39.06
Total	80,187	82,011	−2.22
Radial	67,959	66,713	1.87
Production	67,038	73,168	−8.38
Radial	59,597	58,049	2.67
Truck & Bus Tires			
Shipments			
Original Equipment	3,037	3,386	−10.31
Radial	2,013	2,152	−6.46
Replacement	12,022	12,166	−1.18
Radial	5,646	5,056	11.67
Total	15,638	16,151	−3.18
Radial	8,020	7,525	6.58
Production	13,240	15,462	−14.37
Radial	6,370	6,690	−4.78

with sales totalling $38 million.

Polysar reported 1985 sales of 1.8 billion with net income of $122,000.

Markets, news

Worldwide demand for rubber will grow at a faster pace than tire supply because of the large gains expected in nontire rubber demand, especially in newly industrializing countries, a study by The Freedonia Group projects. *World Rubber and Tire Markets* sees sizable gains for hose, belting, medical disposables and a multitude of industrial and consumer products made from rubber. Nontire rubber demand in the developed countries of North America, Western Europe and Japan will only marginally expand, due to market saturation, the increased substitution of rubber by plastics in many applications and the gradual shift in the manufacture of these fabricated rubber goods to developing countries such as those in Latin America. The gradual shift in tire supply to these developing countries will further push rubber demand in this direction. By 1989, world rubber demand will reach 15 million metric tons, reflecting an average 2.8% increase over 1984 the TFG report says.

Researchers at Texas A & M university have discovered that cold temperatures increase rubber production in guayule. Using an electron microscope and advanced nuclear magnetic resonance technology, the scientists analyzed guayule plants grown at Fort Stockton and their analysis indicates the average rubber content per plant increases by about one-fifth of an ounce between August and January. They've also found that the rubber transferase, the enzyme responsible for synthesizing rubber in the plant increased by 50 times from November to January. "Guayule plants apparently need hot, dry summers to produce large amounts of biomass and cold winters to convert stored carbohydrates in the stem into rubber," Dr. Chauncey Benedict said. Discovering that the enzyme is genetically regulated by cold temperatures means that scientists may be able to use chemical regulators to turn on the gene coding for the enzyme synthesis during summer, Benedict said.

World rubber demand (000 metric tons)

	1984	1989	1995	ann. growth
Rubber Demand	13136.9	15064	17800	2.8
natural	4278.2	4929	5830	2.9
synthetic	8858.7	10135	11970	2.7
tire	5921.5	6214	6696	1.3
nontire	7315.4	8850	11104	3.9
United States	2811.8	2995	3290	1.3
USSR	2156.0	2445	2760	2.6
Japan	1440.0	1620	1880	2.4
W. Germany	588.0	635	685	1.6

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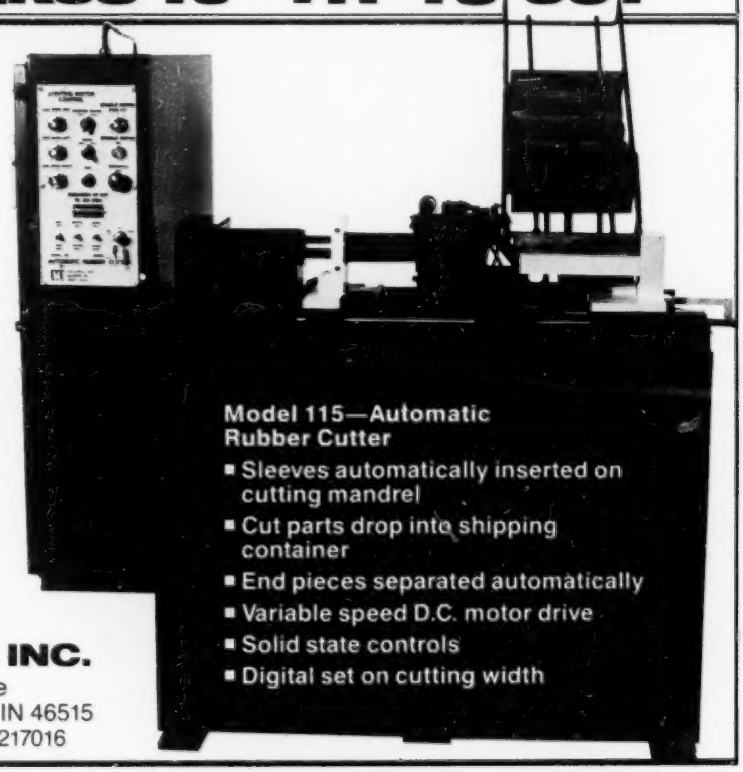

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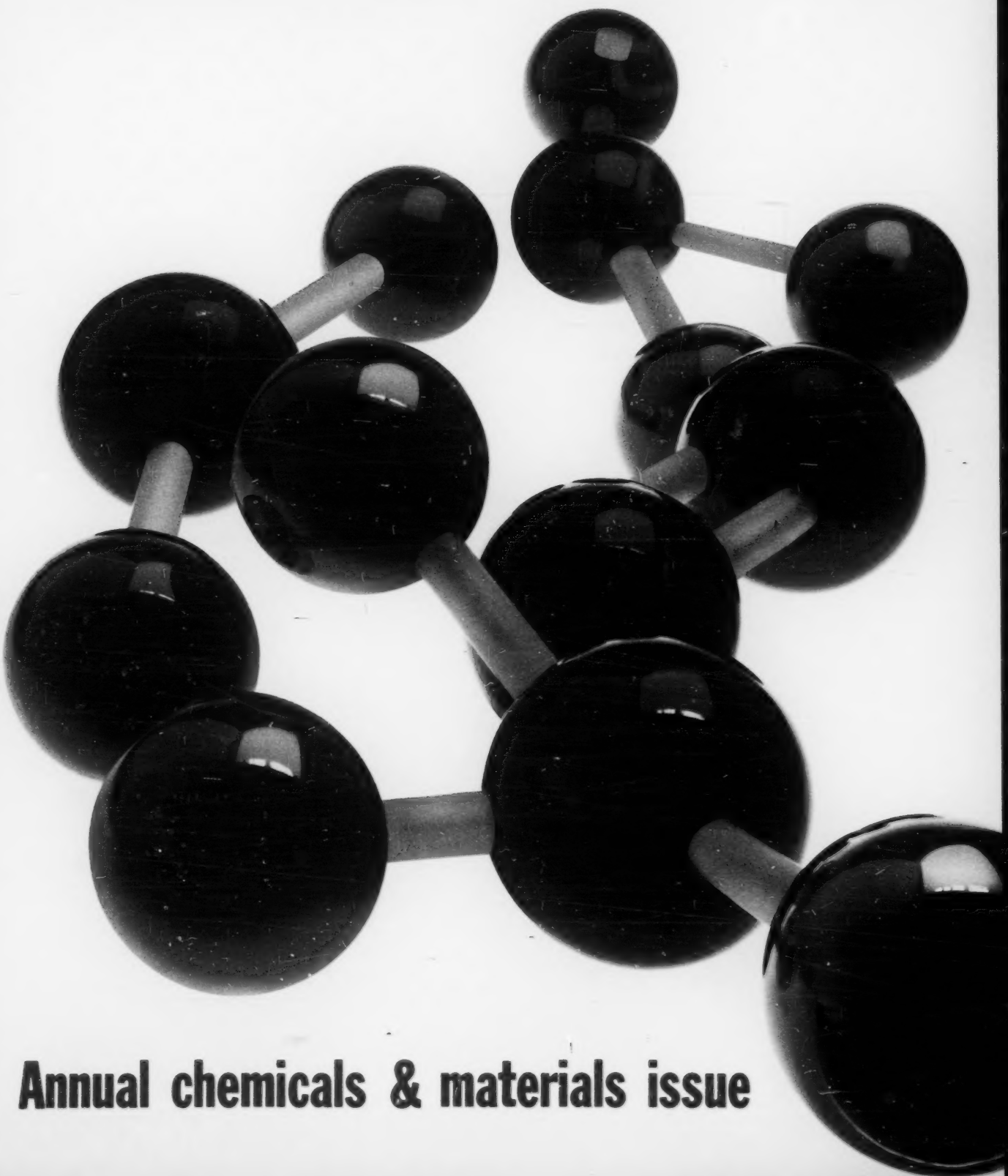
The technical service magazine for the rubber industry

Volume 195, No. 1

October 1986



Annual chemicals & materials issue

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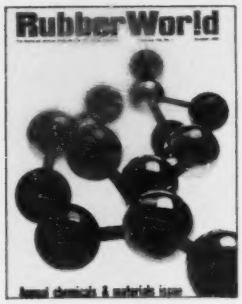

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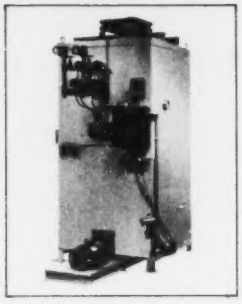

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12 Tech Service: Follow the bouncing...

by Jon Menough, contributing technical service editor. The Yerzley Oscilograph has been refined making it a much simpler test to perform offering a different way of looking at a rubber sample.

14 Quality Management: Quality improvement- the seven deadly sins

by David Crosby, Crosby & Co. A look at what are generally the weak spots in quality improvement activity.

18 Urethane Forum: The PMA and SPI fall meetings

by Bill Stahr, Brad & Associates. The two upcoming urethane industry meetings are previewed.

21 New developments in prevulcanization inhibition

by A.B. Sullivan, Eiichi Morita and R.I. Leib, Monsanto Chemical Company. Article describes development of hexa (isopropylthio)-melamine and shows that the overall reactivity with MBT is similar to that of CTP (N-cyclohexylthiophthalimide) and has the same inhibitor activity (per equivalent of S-N) as CTP in various polymer and accelerator systems.

29 CPE thiadiazole cure system studies - chemistry and dispersion

by William H. Davis, Jr., Dow Chemical U.S.A. and James H. Flynn, Teknor Apex. Authors discuss thiadiazole cure systems for CPE that provide more flexibility than peroxide-based cure systems. They also discuss a mechanistic study of the cure system and significant improvements in scorch safety and shelf life by using magnesium hydroxide as the inorganic base in this system.

35 New considerations in the selection of fluorocarbon elastomers for seal applications

by Robert A. Brullo and Allen M. Sohio, 3M. Preconditioned motor oils were used to study the effects on fluoroelastomer compounds used in oil seals. Fluoroelastomer parameters to prevent oil additive attack were determined and used to devleop oil seal compounding guidelines.

39 Recent advances in thermal black

by D. W. Gorman, R. T. Vanderbilt. Author reviews properties of thermal black and describes their use in compounding of natural rubber, SBR, neoprene, EPDM, fluoroelastomer, acrylic and epichlorohydrin.

43 Patent News *edited by Bob Samples, Akron Rubber Development*

97 Technical Focus *by David Given, technical editor*

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New equipment, instruments, CAD/CAM, products and materials

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Business Briefs

its headquarters to Charlotte, NC.

General Tire is undergoing a multi-million dollar farm tire expansion at its Mayfield, KY facility. The expansion is expected to be completed by next spring and will mean the addition of 125 new employees.

Carlisle SynTec Systems opened its Fredricksburg, VA distribution center which will stock the company's complete line of single-ply roofing membrane, adhesives and sealants.

Smith & Nephew of Great Britain purchased **Richards Medical Co.**, Memphis, TN, an orthopedic products company with six U.S. manufacturing plants and three in Europe and subsidiaries in 10 other countries.

BTL Industries completed acquisition of the majority of the businesses formerly comprising the specialty phenolics division of **Reichhold Chemicals** and has formed BTL Specialty Resins Corp.

RMA rubber report through June (figures in metric tons)

	cumulative 1986	cumulative 1985	% change
Total new rubber			
New rubber available	1,552,126	1,542,424	.63
Imports	542,101	574,702	-5.67
Exports	191,008	188,247	1.47
Apparent consumption	1,329,462	1,341,029	-.85
Total natural rubber			
Imports	405,802	434,940	-6.70
Exports	19,839	20,432	-2.90
Apparent consumption	384,482	415,195	-7.40
%total new rubber	28.92	30.96	
Total synthetic rubber			
Production	1,010,025	967,722	4.37
Imports	136,299	139,762	-2.48
Exports	171,169	167,815	2.00
Apparent consumption	944,980	925,833	2.07
Total SBR			
Production	386,138	392,921	-1.73
Imports	53,622	46,775	14.64
Exports	48,669	42,381	14.84
Apparent consumption	380,552	398,696	-4.55
Total nitrile			
Production	32,454	28,391	10.42
Imports	6,218	6,510	-4.49
Exports	5,146	3,429	50.07
Apparent consumption	32,062	31,448	1.95
Polybutadiene			
Production	177,898	180,020	-1.18
Imports	27,331	36,327	-24.76
Exports	11,052	12,374	-10.68
Apparent consumption	177,543	197,882	-10.28
Ethylene-propylene			
Production	118,078	120,957	-2.38
Imports	2,264	503	350.10
Exports	23,171	17,175	34.91
Apparent consumption	94,878	95,872	-1.04
Butyl, polychloroprene, polyisoprene, silicone and other synthetic elastomers			
Production	295,458	244,432	20.88
Imports	46,864	49,647	-5.61
Exports	83,131	92,456	-10.09
Apparent consumption	259,946	201,933	28.73

Contracts, licenses

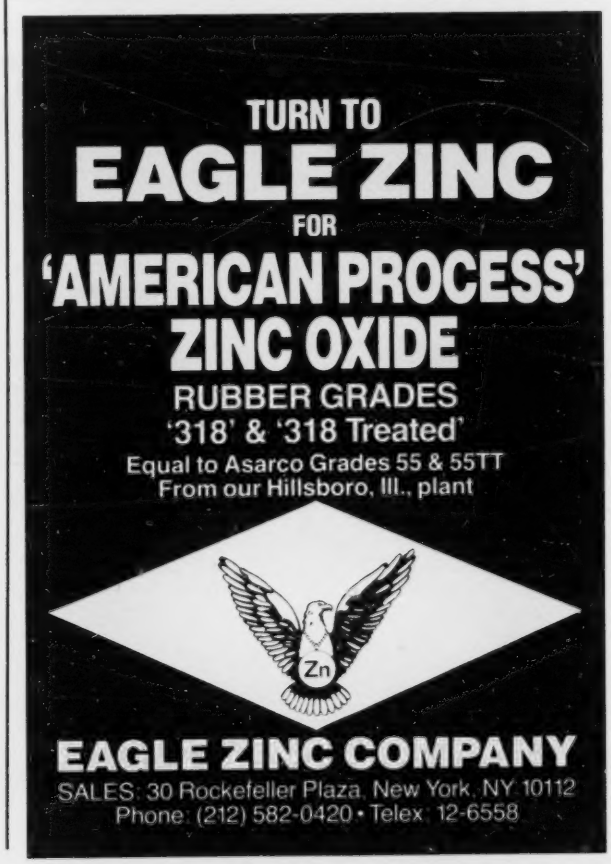
KMG Minerals, formerly English Mica, appointed **Walsh and Associates**, St. Louis, MO as a stocking distributor for its products.

Financial statements

The British Petroleum Co. reported a profit for the quarter ending June 30 of $317 million on revenues of $9.5 billion.

Cabot Corp. had a third quarter net income of $13.1 million on sales of $310.1 million.

Eagle-Picher reported net income for the third quarter of $9.4 million on sales of $153.7 million.



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Business Briefs

GenCorp reported third quarter net income of $38 million on net sales of $807 million.

NL Industries had a second quarter net loss of $50.4 million on sales of $315.9 million.

Markets, news

Rapra, the Rubber and Plastics Research Association of Great Britain estimates that the free world market for specialty elastomers, excluding chlorinated PE is between 165,000-185,000 metric tons per year. This represents 1.8% of total rubber consumption of 9.5 million tons according to *Specialty and high perfomance rubbers*, a business report prepared by the group. In terms of value, these rubbers account for sales of $900 million to $1.05 billion which is about 7-8% of total rubber markets and about 10% of total synthetic rubber usage. Silicones make up the largest volume with approximately 60,000 tons consumed in 1985. Chlorosulphonated PE was next with 40,000-50,000; acrylics at 30,000; copolyester/polyethers at 15,000; epichlorohydrin with 10,000-15,000; polysulfides at 5,000-10,000, fluoroelastomes at 5,000; polynorbornene between 1,000-2,000, and propylene oxide copolymers accounted for less than 1,000 tons. Although fluoroelastomers ranked sixth in volume it was placed second according to value by the report.

Bayer AG predicts usage of thermoplastics will reach 4.7 million tons by 1990, a half million ton increase from 1985 consumption. The company also sees consumption of polyurethanes increasing to 4.5 million tons in 1990 from 1985's level of 3.6 million tons.

Goodyear is phasing out its machinery fabricating division in Akron stating that fabricating and assembling complete machines or tooling fixtures at the plant for shipment to various plants is no longer compatible with new methods for installation of integrated manufacturing systems in today's modern plants The phaseout affects 188 employees while 87 jobs will be preserved by an $8.9 million investment in a new machine and systems development facility in Akron.

Lydall Inc. will close the Chicago, IL plant of its elastomer products group by the end of this year. The plant has been a manufacturer of molded rubber parts for nearly 35 years.

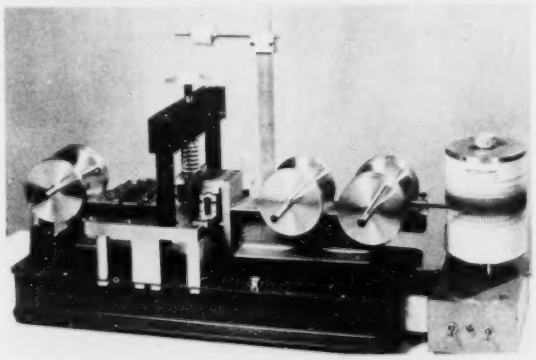
Goodyear is urging renegotiation of the International Natural Rubber Organization (INRO) treaty to avoid what it calls havoc in the market, economic repercussion in the rubber producing nations and possible jeopardy to the long term supply outlook. Failing that, Goodyear said that member nations of the INRO treaty should institute an orderly release of natural rubber buffer stocks when the current agreement expires in October 1987.

The price for RSS 1 natural rubber reached .4675 cents per pound on Sept. 26, its highest mark since August of 1984. Prices for RSS 1 had bottomed out at 39 cents per pound on May 2 of this year. Prices for RSS 1 were near 60 cents per pound in January 1984.

RMA tire report through July
(figures in thousands of units)

Passenger tires	YTD 1986	YTD 1985	%change
Shipments			
Original equipment	32,602	32,906	-0.92
Radial	27,330	25,446	7.40
Replacement	74,438	84,401	-11.80
Radial	63,819	63,171	1.03
Export	2,175	3,507	-37.98
Radial	1,646	2,592	-36.50
Total	109,215	120,814	-9.60
Radial	92,795	91,209	1.74
Production	91,172	101,247	-9.95
Radial	77,033	75,661	1.81
Truck & bus tires			
Shipments			
Original equipment	4,138	4,582	-9.69
Radial	2,749	2,869	-4.18
Replacement	16,161	17,971	-10.07
Radial	7,619	7,625	-0.08
Export	762	797	-4.39
Radial	466	405	15.06
Total	21,061	23,350	-9.80
Radial	10,834	10,899	-0.60
Production	17,956	20,161	-10.94
Radial	8,657	8,740	-0.95

ADVANCED "AYO—II" and COMPUTERIZED "CYO-III" YERZLEY OSCILLOGRAPHS are NOW available.



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